DEC STD 016-0 Printed-Wiring Board and Module Manufacturing Terminology

DOCUMENT IDENTIFIER: A-DS-EL00016-00-0000 Rev D, 17-Jan-1992

ABSTRACT: This manufacturing standard establishes terms and definitions to assure consistent use of all printed-wiring board and module manufacturing terminology that might appear in Digital documents.

APPLICABILITY: Mandatory for Digital personnel who use printed-wiring board and module manufacturing terms in Digital documents.

STATUS: Approved 17-Jan-1992; use VTX SMC for current status.

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APPROVAL: This document has been reviewed and recommended for approval by the General Review group for its category and the DEC STD 016-0 Advisory Committee.

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CONTENTS

1 INTRODUCTION 1
1.1 PURPOSE 1
1.2 SCOPE 1
1.3 RESPONSIBILITIES 1
1.3.1 Originators of Digital Documents 1
1.3.2 Printed-Wiring Boards and Module Manufacturing Terminology Standards Committee 1

2 TERMS AND DEFINITIONS 1

Appendix A REFERENCED DOCUMENTS 85

A.1 EL-Class Digital Documents 85

A.2 Other Documents 85

A.3 Ordering Information 85

FIGURES

1 Access Holes 3
2 Anchoring Spur 4
3 Beveling 8
4 Blind/Buried Via Hole 9
5 Bow 10
6 Breakout 10
7 Center-to-Center Spacing 12
8 Clearance Hole 14
9 Clinched Lead 14
10 Clinched-Wire Through Connection 15
11 Conductor Imperfections 17
12 Conductor Spacing 17
13 Corner Mark 19
14 Crazing 20
15 Critical Contact Area 21
16 Crop Mark 21
17 Crosshatching 22
18 Delamination 24
19 Dewetting 25
20 Edge Taper 27
21 Elongated Pad 29
22 Etchback 30
23 Etch Factor 31
24 Etching Indicator 31
25 Fillet 33
26 Finger 34

27	Ground/Power-Plane Clearance	37
28	Gull-Wing Lead	37
29	Heat Sink	38
30	J-Bend Lead	43
31	Layer-to-Layer Spacing	44
32	Leadless Chip Carrier (LCC)	45
33	Multilayer Board	50
34	Nailheading	51
35	Nonwetting	52
36	Notch	52
37	Overhang	53
38	Peak-to-Valley	56
39	Planar Surface	57
40	Plated-Through Hole (PTH)	58
41	Plated-Through Hole Imperfections	58
42	Plating	59
43	Register Mark	64
44	Shadowing	67
45	Stackmaster	71
46	Tenting	74
47	Test Coupon	75
48	Test Pattern	75
49	Twist	78
50	Undercut	79
51	Wire Ink	81

1 INTRODUCTION

1.1 PURPOSE

This standard stabilizes the use of printed-wiring board and module manufacturing terminology in Digital documents.

1.2 SCOPE

All commonly used terminology for printed-wiring board and module manufacturing should be in this manufacturing standard. In most cases, only the preferred term is defined. Where more than one term is acceptable or where a term may be better understood in relation to another, the words *see* or *refer to* cite the appropriate term. But where only one term is preferred for a particular definition, the word *use* cites the preferred term.

1.3 RESPONSIBILITIES

1.3.1 Originators of Digital Documents

Originators of Digital documents should attempt to use only the preferred terms as they are defined in this standard. Where a serious disagreement exists, the person involved should initiate a change to this document. In this way, the stabilization process will continue as printed-wiring board and module manufacturing terminology changes at Digital.

1.3.2 Printed-Wiring Boards and Module Manufacturing Terminology Standards Committee

The printed-wiring boards and module assembly standards committee is responsible for the content of this standard. The members of this committee must review and approve all proposed changes. Any comments or requested changes should be addressed to Rich Barnett, LJO1/B2, DTN: 226-2045, BOARDS::BARNETT.

Committee Members:

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2 TERMS AND DEFINITIONS

Printed-wiring board and module assembly terms and definitions are arranged alphabetically on the following pages.

A

absorption — The amount of moisture a given substance will assimilate and retain. Absorption is an important property consideration in the selection of insulating materials.

accelerator — A chemical that speeds up a reaction or the curing of a plastic, often used with a catalyst, hardener, or curing agent.

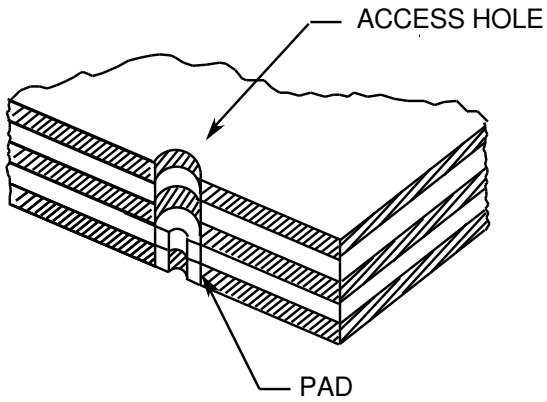
acceptable minimum — The least degree of quality that will be accepted by Digital standards and product engineering documentation. (*Acceptable minimum* shall prevail when specific information does not appear on product engineering documentation. Product engineering documentation may define specific quality requirements that take precedence over general workmanship standards.)

acceptable preferred — The most desirable level of acceptability.

acceptance tests — Those tests deemed necessary to determine acceptability of product as agreed to by purchaser and vendor.

access holes — A number of holes in a multilayer printed-wiring board with a common center or axis to provide access to the surface of the land in one of the board layers. For example, impedance testing on particular inner layers. See Figure 1.

Figure 1: Access Holes



acidified rinse — An acidulous (slightly acid) water rinse.

activating — Changing a passive metal surface to a chemically active state; using chemical treatment to make nonconductive material receptive to the electroless deposition of metal.

active — An element or component, such as a diode or transistor, that changes its basic value when an electrical signal is applied.

active component/package — Integrated circuit devices such as analog and/or digital circuits in a single package or hybrid form.

additive process — Process that produces conductive patterns through the selective chemical (electroless) deposition of conductive material on unclad base material. Refer to *fully-additive process* and *semi-additive process*.

adhesion — Use *bond strength*.

adhesion promotion — Chemical preparation of a plastic surface to provide for a uniform well-bonded metallic overplate. Refer to *activating*.

admittance — The measure of ease with which an alternating current flows in a circuit. The reciprocal of impedance.

adsorption — The adhesion of gas or liquid molecules to the surfaces of solids or liquids with which they are in contact.

aerial oxidation — Results from the exposure of photographic chemicals to air during developing.

air ionizer — A device that neutralizes electrostatic charges by ionizing air molecules, forming both positive and negative ions. The positive ions are attracted to negatively charged bodies and the negative ions to positively charged bodies, resulting in charge neutralization.

alkaline cleaner — A chemical solution used for cleaning boards, blended from alkali hydroxides and alkaline salts such as borates, carbonates, phosphates or silicates. Cleaning action may be enhanced by the addition of surface-active agents and special solvents.

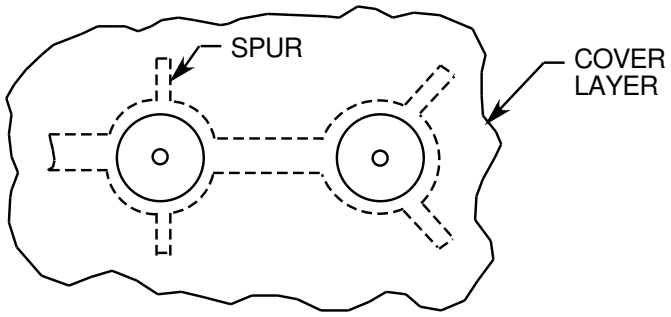
all copper technology — A process of fabricating printed-wiring boards without having tin lead fused or hot air solder leveled. This process results in a finished circuit absent of any solder coating. The bare copper surface is coated with a chemical compound (Benzotriazole), which safeguards against oxidation.

ambient — The surrounding environment coming into contact with the system or component in question.

ambient temperature — In degrees Fahrenheit and Celsius, the temperature of the immediate area surrounding the item in question; may or may not be the same as room temperature.

anchoring spur — In flexible printed-wiring, a pad extension beneath the cover layer that assists in holding the pad to the base material. See Figure 2.

Figure 2: Anchoring Spur



ankle strap — Use *ground straps*.

annotation — Printed information appearing off or on the board area pertinent to the board design.

anodize — To coat a metallic surface, electrolytically, with a protective oxide.

annular ring — Conductive material that completely surrounds a plated-through hole. Refer to *minimum annular ring* and *pad*.

antioxidant agent — A chemical compound such as Benzotriazole (BZT) that is used as an antioxidant coating for all-copper boards. The compound forms a thin coat that acts as a protectant from oxidation.

antistatic clothing — Specialized clothing made of antistatic electrostatic discharge (ESD) protective material. See also *ESD protective clothing*.

antistatic ESD protective material — Those materials that resist triboelectric charging and produce minimal static electricity when separated from themselves or other materials. A material's antistatic property is not necessarily correlated with its resistivity.

antistatic footwear — Specialized footgear of antistatic ESD protective materials to provide ESD protection.

antistat impregnated plastic — Any specialized plastic that provides sufficient triboelectric charging protection to be an ESD protective material. Although some antistat agents, especially hygroscopic ones, might slightly increase the surface conductivity of the base plastic, the resultant conductivity is usually insufficient to provide Faraday cage shielding. Examples are *Pink Poly* and *Blue Poly*.

arc resistance — Stated as the time required by a particular high-voltage low-current arc to form a conductive carbonized path across the surface of the material being measured.

archive data structure (ADS) - An ASCII file format used for archiving electrical product designs (PCBs or MCA chips for example) created using the IDEA II or VLS PCB Layout systems. It is also used to transfer designs between those internally-developed PCB layout sytems and other vendor ECAD packages in use within Digital.

artwork — An accurately scaled master configuration that is used to produce the printed circuit pattern. Refer to *artwork copy*, *artwork master* and *production master*.

artwork copy — Usually on Mylar® and made from the production master; used in screen preparation for generation of stencil screens or inserted in a phototool for use in dry-film printing.

artwork master — The original artwork used to manufacture a particular printed-wiring board within the accuracies specified on the master drawing. Computer-plotted or hand-taped as a one-to-one scale pattern and produced on glass or film, the artwork master either serves as the production master or is used to make the production master. A single-image artwork master is used for fabricating one board at a time; a multiple-image artwork master is used for fabricating two or more boards simultaneously.

artwork preparation — Generation of artwork copies and phototools (for image transfer operations) and drilling and routing tapes.

aspect ratio — The ratio that exists between the board thickness and the finished hole (via) diameter. As this ratio increases beyond 5:1, drilling and plating within the PWB manufacturing process becomes more difficult.

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Aspect ratio = Board thickness (mils)/minimum via size (mils)

assembly — A number of parts or subassemblies, or any combination thereof, joined together to perform a specific function. Refer to *backplane assembly* and *printed board assembly*.

assembly and equipment ESD classification — Method of ESD classification for electronic assemblies and equipment. Classification is based on either the most ESD susceptible (ESDS) part in the assembly or by detailed circuit analysis of the voltage protection afforded by ESD input protection circuitry incorporated for the ESDS parts in the assembly or equipment.

autothieving — A process that adds nonfunctional plating to the surface of printed-wiring boards to equalize the current density gradient during the electroplating process.

B

B stage — The condition of a resin polymer when it is more viscous, with higher molecular weight, and insoluble but plastic and fusible.

background — In artwork, the surface area that contrasts with the conductor pattern.

backpanel — A printed-wiring board used in a backplane assembly. Use *mother board*.

backplane assembly — Holds the connector-pin blocks and wire wrapping that interconnect arrays of electronic modules (boards) not mounted on the backplane; it may or may not contain a printed-wiring board.

baking — A heating operation that removes entrapped moisture, thereby stabilizing shrinkage and relieving stress in a subsequent process or operation.

bare board — Use *printed-wiring board*.

base — In photography, the clear supporting material underlying the emulsion. Polyester, acetate, and glass are used as photographic bases.

base laminate — The base material in copper-clad laminates that provides insulating support for printed-wiring boards or printed circuits.

base material — Rigid or flexible insulating material on which the conductive pattern is formed; also used to separate, insulate, and bond conductive layers in multilayer boards. Refer to *prepreg* or *base laminate*.

base material thickness — A measurement from one surface to the opposite excluding metal foil and any other material deposited or plated on the surfaces.

basic dimension — Theoretically exact without tolerance; the basis for permissible variations that are established by tolerances. Refer to *true position*.

basic grid — Use *grid*.

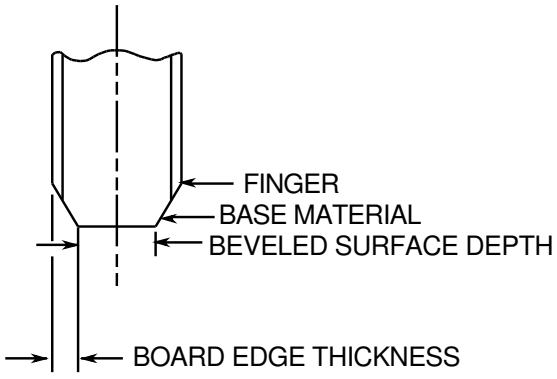
bath — Use *chemical solution*.

bellows contact — A connector contact (flat spring) folded to provide a uniform spring rate over the full tolerance range of a mating finger.

bent lead — Bent at approximately 45 degrees or formed to be in direct contact with an offset pad.

beveling — As delineated in Figure 3 in vertical cross section, a board edge modification that permits easier insertion of the fingers into an external connector. See Figure 3.

Figure 3: Beveling



bifurcated contact — A connector contact (usually a flat spring) slotted lengthwise to provide additional independently operating points of contact with a mating finger.

bird-caging — Stranded wires separated generally in the area between insulation and terminal points.

bismaleimide triazine (BT) — A type of polymerization resin system that is based on reactions involving bismaleimide (BMI) derivatives. The major advantage of BMI resins is their low processing temperature in comparison to other polyimides. Normally, these resins can be cured at 175°C, which is the same range for epoxies.

If epoxy processing equipment is used, a post cure at 245°C must be performed to complete the polymerization. [Typical properties: Er = 3.0 , Tg = 190°C.]

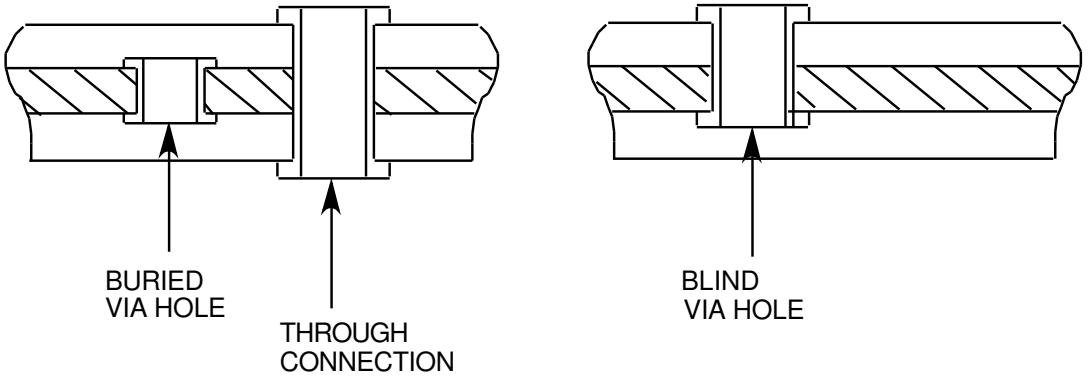
blank — Unprocessed piece of prepreg or copper-clad laminate having the rough dimensions of a printed-wiring board.

bleeding — Process material or solution discharges from crevices or voids in a plated hole.

blind hole — A hole drilled into material without going completely through the material. Only one end of the hole is accessible.

blind via — A mechanically drilled plated-through hole that electrically connects one internal layer to the external layer of a multilayer PWB or substrate. This via does not provide a through connection from one external layer to the other. See Figure 4. Refer also to *interstitial via hole*.

Figure 4: Blind/Buried Via Hole



blister — A form of delamination caused by trapped air or gas, evidenced by localized swelling and separation of laminated base material or of base material and conductive foil. In base material, blister appears as a relatively uniform and cloud-like (irregular, rounded, lighter in color) pattern below the surface.

blister foil — A localized separation between the base material and the conductive material.

blister interlaminar — A void produced under the surface of a laminated material and is a form of delamination. See Figure 18.

blow hole — Small hole or cavity larger than the lead diameter in the vicinity of a plated hole or solder joint, caused by escaping gas during solidification. The gas results from moisture or contaminant entrapment and the subsequent application of heat. Use *void*.

board — A board is the component that is delivered to the stage 1 assembly shop for insertion and test. It may contain the circuit and tooling for stage 1 assembly. Each board may contain more than one circuit. Use *printed-circuit board* or *printed-wiring board*.

board data drawing — A mechanical detail drawing that specifies the outside configuration of a printed-wiring board including any slots, notches, and cutouts.

board shop — A facility for manufacturing printed-wiring boards.

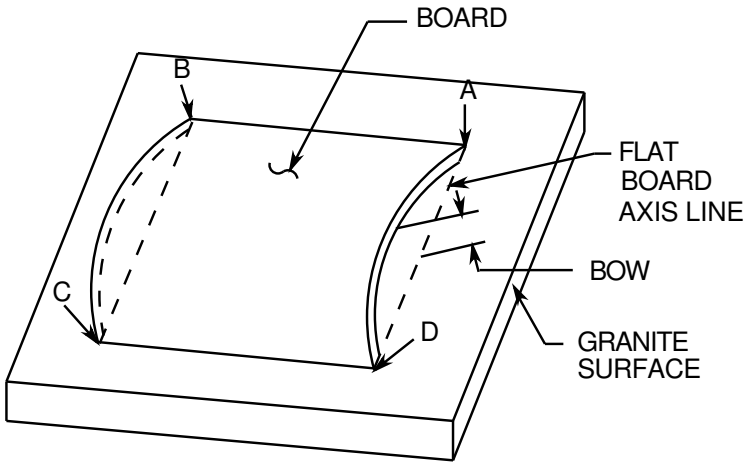
board thickness — For plug-in modules, a measurement from one surface to the opposite including base material, copper foil, and any other material deposited or plated on the surfaces (usually measured in the fingered area). Board thickness of nonplug-in modules usually includes only base material.

bonding layer — Adhesive layer (for example, prepreg) used during lamination to bond together other discrete layers of a multilayer board.

bond strength — A measure (lb/in or kg/mm) of the force required to separate a layer of conductive material from the adjoining base by a perpendicular pull applied to the surface of the conductive material. Use *peel strength*.

bow — A roughly cylindrical or spherical curvature deviating from the flatness of a rectangular sheet, panel or board with its four corners in the same plane. Refer to *twist*. See Figure 5.

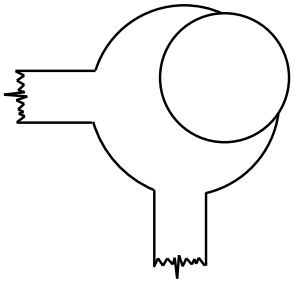
Figure 5: Bow



braid — A machine-woven textile yarn of fine metallic wire covering applied over the wire.

breakout — A hole protruding beyond the edge of a pad or annular ring; may occur when hole and pad are not concentric. See Figure 6.

Figure 6: Breakout



bridging — Electrical bridging is the formation of an unwanted conductive path between conductors, usually consisting of solder.

brightener — A chemical solution used in plating processes to produce a bright surface on immersed metal.

brown line — A diazo reproduction of the latest approved artwork; used as an overlay for pattern image verification.

B-stage material — Use *prepreg*.

B-stage resin — Epoxy resin in an intermediate state of cure that is normally completed during the lamination process.

buried via — A mechanically drilled, plated-through hole that electrically connects one internal layer to an adjacent internal layer within a multilayer PWB or substrate without connecting to the external layer. See Figure 4.

burr — Featherlike projecting cross-section developed on the edge of metal during punching, drilling, shearing and notching operations.

bus bar — A conductor that distributes electrical energy. Use *plating bar* or *power plane*. In addition to being an etched conductor, a bus bar can also be a copper strip that is added to a board after etching.

bus wire — A solid conductor used to connect two or more terminals. There are two types: insulated and non-insulated. Use *jumper*.

butter coat — An external layer of resin over the reinforcing structure of base material. Refer to *resin-rich*.

C

C stage — The condition of a resin polymer when it is in the solid state, with high molecular weight, being insoluble and infusible.

camera reduction — Photographically reducing the size of accurately scaled artwork; the product produced by such a process.

capacitive coupling — Electrical interaction between two conductors caused by the capacitance between them.

card — Use *printed-circuit board* or *printed-wiring board*.

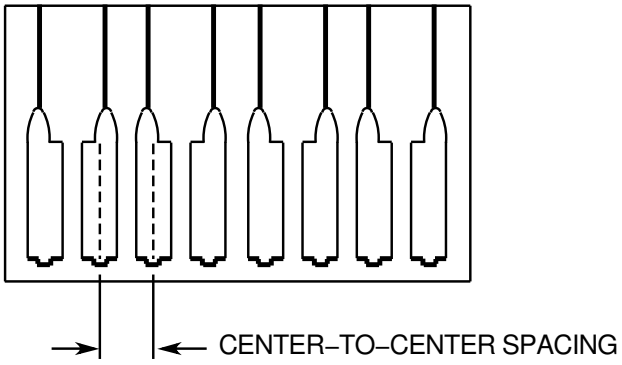
castellation — The vertical metallized portion of the leadless chip carrier pad. See *EL-MF417-01, Surface Mount Technology Reference Manual - 2 volume set*, Figure 3.2.

catalyzing — Use *activating*.

catastrophic failure — A failure that is both sudden and complete; that is, it could not be anticipated by prior examination or monitoring and involves complete loss of the required function. Catastrophic ESD failures can be the result of electrical overstress (EOS) of electronic parts caused by an electrostatic discharge such as a discharge from a person or object, an electrostatic field, or a high-voltage spark discharge.

center-to-center spacing — Distance between centers of adjacent conductors or holes on any single layer of conductors in a printed-wiring board; also called centric spacing. See Figure 7.

Figure 7: Center-to-Center Spacing



ceramic leaded chip carrier(CLCC) — A ceramic leaded package for semiconductor dies.

cerquad — A ceramic, surface mount device with gull-wing leads along all four edges.

certification — Verification that specified testing has been performed and required values have been obtained.

chamfer — Eliminates sharp edges at corners of boards, allowing easier insertion of fingers into an external connector. Refer to *beveling*.

characteristic impedance — A parameter that is measured and used to monitor the printed-wiring board's final electrical properties. This may be defined as the apparent opposition in a circuit to the flow of alternating current. It comprises inductive reactance, capacitive reactance, resistance, and conductance. See *controlled impedance*.

checking — Fine hairline cracks in the surface of a board.

chemical deposition — Use *electroless deposition*.

chemical hole cleaning — Removing resin (epoxy) smear or otherwise cleaning conductive surfaces exposed within a drilled hole on a multilayer board. Refer to *etchback*.

chemical solution — Wherever possible use this term instead of such nouns as "dip" or "bath."

chemically deposited printed-wiring/circuit — Refer to *additive process*.

chip on board(COB) — A technique for directly bonding a bare semiconductor chip to a printed-wiring board or ceramic substrate. Typically, a silver-filled epoxy adhesive is used to bond the chip to the board. Following wire bonding, a "glob-top" material or other liquid form is usually applied as encapsulation of the chip, which is then cured to provide device protection.

circuit — A complete printed-wiring board fabricated on a multiboard production panel. Use *printed-wiring board*.

circuit card — Use *printed-circuit board* or *printed-wiring board*.

circuit hole — Use either *component hole* or *plated-through hole*.

circuit pattern — Use *conductive pattern*.

circuit schematic — An engineering drawing composed of graphic symbols that show the connections, components, and functions of board circuits.

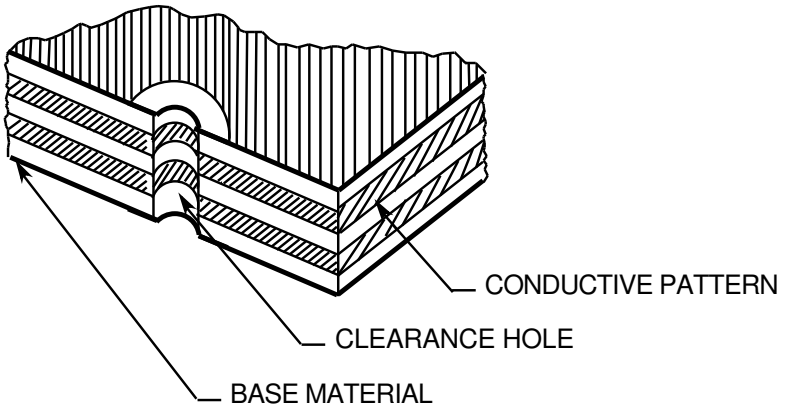
circumferential separation — A circular crack around the inside of a plated-through hole; may be deep within the hole or near the top. Also designates a crack at the interface of a solder fillet and pad or a crack in the solder fillet around an eyelet or lead wire.

cladding — A sheet of conductive foil bonded to base material (for example, the foil in copper-clad laminate).

classification testing — The testing procedures used to determine the ESD susceptibility class of parts. See ESD device classification.

clearance hole — A hole in the conductive pattern larger than but coaxial with a hole in the base material. See Figure 8.

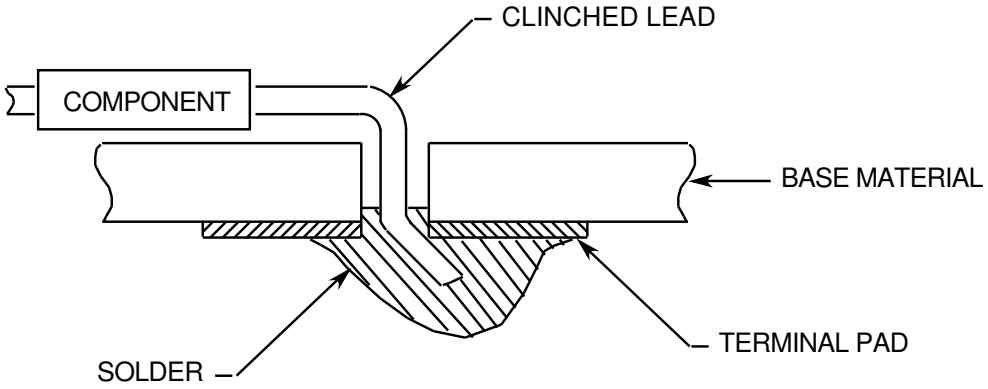
Figure 8: Clearance Hole



clearance hole technique — A fabrication technique for producing multilayered printed-wiring boards wherein all terminal areas on each of the conductive layers are exposed directly to dip soldering in assembly of components. Use *access hole*.

clinched lead — A component lead that is passed through the printed-circuit board and then bent to hold the components in place on the board prior to wave soldering. See Figure 9.

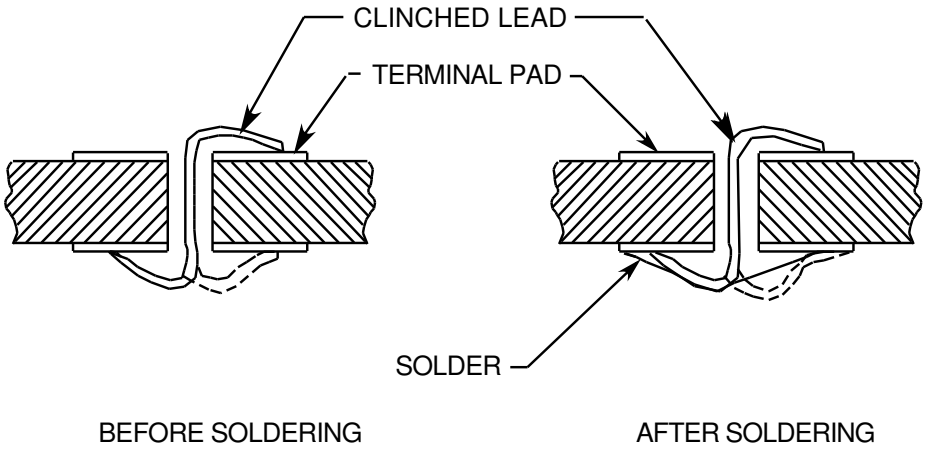
Figure 9: Clinched Lead



clinched-wire interfacial connection — Use *clinched-wire through connection*.

clinched-wire through connection — A connection made by a wire that is passed through a hole in a printed-circuit board, and subsequently formed or clinched, in contact with the conductive pattern on each side of the board, and soldered. See Figure 10.

Figure 10: Clinched-Wire Through Connection



clouding — A cloudy or foggy effect in the clear area of a pattern image resulting from a residual silver deposit; clouding is caused by stray light striking the emulsion, an aged emulsion, too much heat, or improperly mixed chemicals.

coefficient of expansion — The fractional change in dimension of a material for a unit change in temperature.

cold solder — The required metallic luster is missing and generally the joint has the appearance of rough, piled-up solder with a granulated surface and possesses a chalky, frosty look.

cold solder joint — A solder connection exhibiting poor wetting and a grayish, porous appearance due to insufficient heat, inadequate cleaning prior to soldering, or to excessive impurities in the solder solution.

component — Any electrical, optical, or mechanical device, having distinct electrical, optical, or mechanical characteristics and having terminals for connection to other components to form a circuit, connector, fast tab, or switch.

component assembly — Adding functional parts to printed-wiring boards in order to produce printed-circuit boards. At Digital, this occurs in module assembly areas.

component damage — Components that show visible evidence of physical imperfections of the body, leads, seals, and marking.

component density — The quantity of components on a board per unit area.

component hole — Used in component assembly for the mechanical attachment and/or electrical connection of component terminations, such as pins and wires; may or may not be plated-through.

component lead — A solid or stranded wire, or formed conductor, that extends from a component and is used in making a mechanical and/or electrical connection to the board. A wire lead may or may not be insulated.

component part — See *component*.

component side — The side of a printed-circuit board upon which component parts are mounted. (Commonly referred to as side 1; opposite of soldered side.)

composite board — Use *multilayer board*.

composite printing — A special form of composing patterns by contact printing wherein two or more images are registered and printed in sequence. Refer to *step-and-repeat*.

concave — Curved, like the inner surface of a sphere.

conditioning — Time-limited exposure of a test specimen to a specified environment prior to testing. Also designates the chemical preparation of panel or board surfaces for subsequent operations.

conductive ESD protective material — See *conductive material*.

conductive flooring — Specialized floors or mats made of conductive ESD protective material in order to control ESD levels. Should be used with conductive footwear and ground straps and be grounded through a current limiting resistance for safety.

conductive foam — A conductive ESD protective material used to short together the terminals of an ESDS item.

conductive foil — A form of conductive material (commonly referred to as etch) that covers one or both faces of the base material and the inner layers of multilayer boards.

conductive footwear — Shoes, shoe covers, or heel straps made of conductive material used to prevent charge buildup when employing conductive floors.

conductive material — Those materials that are either metal or impregnated with metal, carbon particles or other conductive materials, or whose surface has been treated with such materials through a process of lacquering, plating, metallizing, or printing. A conductive material for static control purposes shall have a surface resistivity less than 1×10^6 ohms-cms if volume is conductive. A conductive material is not necessarily antistatic.

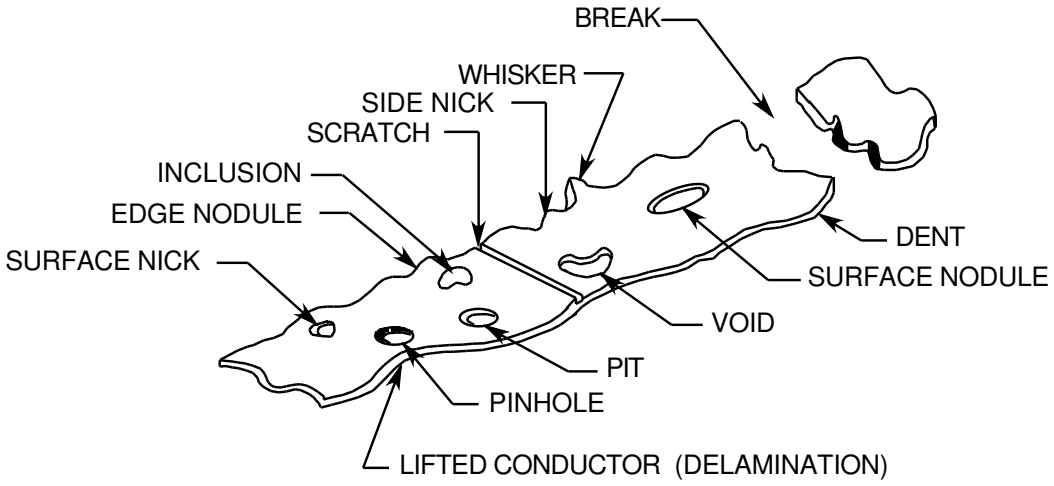
conductive pattern — The configuration or design of the conductive material on the base material. (Includes conductors, lands, and through connections when these connections are an integral part of the manufacturing process, such as additive.)

conductor — A single conductive line or area forming an electrical connection between terminal areas.

conductor base/design width — Refer to *conductor width*.

conductor imperfections — See Figure 11.

Figure 11: Conductor Imperfections



conductor layer — The entire conductive pattern formed on each side of a printed-wiring board.

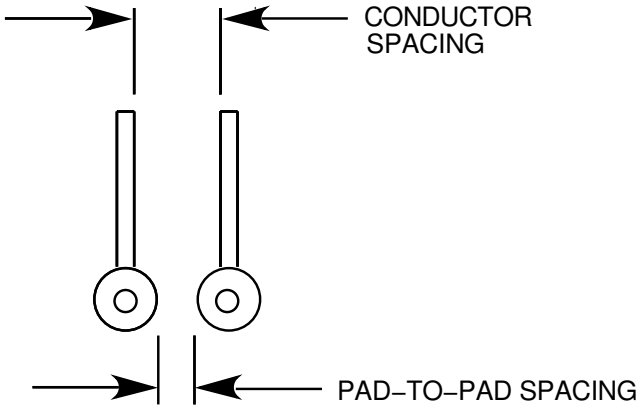
conductor layer 1 — The first conductor layer on or adjacent to the component side of a multilayer board.

conductor pattern — The configuration of conductors on artwork. Refer to *conductive pattern*.

conductor side — Where the conductive pattern is located on a single-sided board, or merely opposite the component side on a double-sided board; the so-called soldered side, commonly referred to as Side 2.

conductor spacing — The distance between adjacent edges of adjacent conductors in a conductor layer. Refer to *minimum electrical spacing*. See Figure 12.

Figure 12: Conductor Spacing



conductor thickness — The thickness of the conductor including all metallic coatings.

conductor-to-hole spacing — The distance between the edge of a conductor and the edge of an unsupported hole.

conductor-to-pad spacing — The distance between the edge of a conductor and the edge of a pad or annular ring surrounding a supported hole.

conductor width — The observable width of the pertinent conductor at any point chosen at random on the printed board, normally viewed from vertically above unless otherwise specified. (Imperfections, for example, nicks, pin-holes, or scratches, allowable by the relevant specification shall be ignored.)

conformal coating — A protective insulating coating that conforms to the overall configuration of a board, usually applied to a fully assembled printed-circuit board.

connection — The means by which electrical contact is made to the conductive pattern.

connector — A separate receptacle assembly containing electrical contacts that will mate with respective fingers on a board to provide reliable connections with external wiring. A connector can also be the terminating end of a cable that is used to connect cable to cable or cable to board.

connector area — The portion of a printed-wiring board used for the purpose of providing external electrical connections.

contact angle — The angle enclosed within the solder fillet between a plane tangent to the solder/base-metal surface and a plane tangent to the solder/air interface.

contact area — The common area between a conductor and a connector through which the flow of electricity takes place.

contact printing — A photographic process in which an image is placed in direct contact with a photosensitive base and exposed.

contact resistance — Under specified conditions, the electrical resistance of metallic surfaces at their interface in the contact area.

contact spacing — The distance between the center lines of adjacent fingers or contact areas. Refer to *center-to-center spacing*.

contaminant — An impurity or foreign substance present in a material that affects one or more properties of the material.

continuity — An uninterrupted path for the flow of electrical current.

control drawing — Use *master drawing*.

controlled impedance — A closely monitored and measured electrical property of a printed-wiring board. The characteristic impedance of a transmission line is dependent on many factors, namely conductor width, conductor thickness, dielectric thickness between conductor and ground/reference plane, and the dielectric constant of the propagating medium. For a controlled impedance design, recognize that the variables are very dependent on each other, and therefore the appropriate formulas must be used for the selected design (for example, microstrip, stripline, buried stripline).

controlled solder plate (CSP) — Process that essentially specifies min/max values for reflowed solder thicknesses on particular SMT features. The min/max values are usually very tightly controlled and/or specified (for example, HPTP requirements [min 300 to 1500 micro-ins]).

convex — Curved or rounded, like the exterior of a sphere.

coordinatograph — A high-precision x and y coordinate plotting machine, consisting of a fixed or rotating table and a movable head on fixed ways, that is capable of precisely locating a point on a line or surface.

coplanarity — The relationship between the seating planes of the individual leads around the periphery of any surface-mount component.

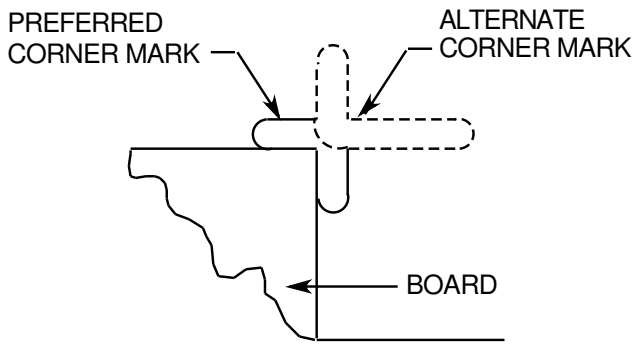
copper — An abbreviated form used to designate foil, plating, or metallic copper.

copper chelating agent — A chemical compound, such as Benzotriazole (BZT), that is used as an antioxidant coating for all-copper boards. The compound forms a thin layer that acts as a protectant from oxidation. Refer to *all copper technology*.

copper-clad laminate — Base material covered with copper foil on one or both sides.

corner mark — A marking at artwork corners, composed of two trim lines, that locates two borders of a printed-wiring board. Two corner marks establish the outline of the board. See Figure 13.

Figure 13: Corner Mark



corrosive — A substance is considered chemically reactive or corrosive if it has the ability to degrade a conductive pattern electrically and/or mechanically.

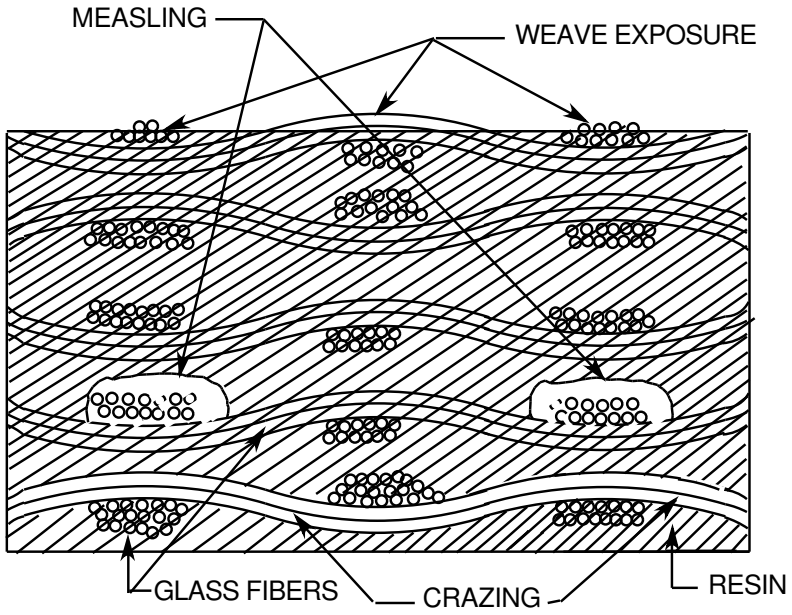
cosmetic defect — A variation from conventional appearance not related to function.

coupon — Use *test coupon*.

cover coat/layer — Outer layer(s) of insulating material applied over the conductive pattern on the surfaces of a board.

crazing — In fiberglass base material, a connected pattern of small irregular spots, crosses, squares or rectangles that appear to be white or at least lighter in color. Caused by mechanical and/or thermal stress, which separates fibers in the glass cloth and connecting weave intersections, crazing forms continuous paths that may carry moisture and therefore electric current. See Figure 14.

Figure 14: Crazing



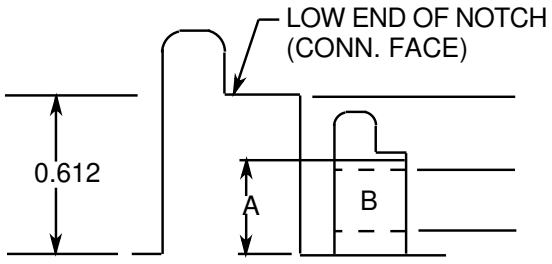
On a conformal coated board, crazing is a network of fine cracks on the surface or within the coating.

creepage — Electrical creepage is the conduction of electricity across the surface of a dielectric.

crest to trough — Use *peak to valley*.

critical contact area — The surface area on each finger that must be clean and properly plated (within a range of allowable imperfections) in order to ensure a good electrical connection to an external connector. See Figure 15.

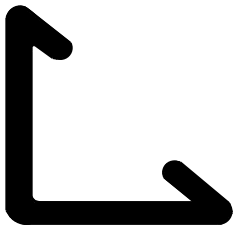
Figure 15: Critical Contact Area



critical defect — A critical defect is one that judgment and experience indicate could result in a potential hazard or unsafe conditions for individuals who use, maintain, or are in the proximity of a unit/assembly/system. Critical defects must be reworked immediately to a safe condition or the potential hazard must be removed. No product with a critical defect may move through the process.

crop mark — Use *corner mark*. See Figure 16.

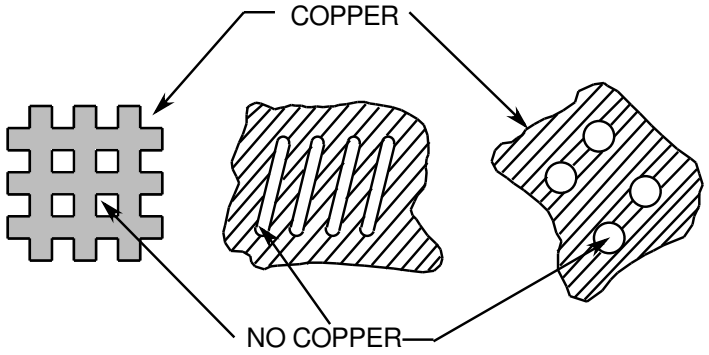
Figure 16: Crop Mark



cross hairs — A feature along the border of artwork that locates the pattern with respect to a fixed reference point or axis. Refer to *register mark*.

crosshatching — Breaking up (relieving) large conductive areas by the use of a pattern of voids in the conductive material to reduce board warpage. See Figure 17.

Figure 17: Crosshatching



cross-link(ing) — The establishment of chemical links between the molecular chains in polymers. Cross-linking can be accomplished by chemical reaction, vulcanization and electron bombardment. The degree of cross-linking depends on the specific polymer. However, the resultant properties are usually improved. Refer to *thermoset*.

cross-sectional analysis — Technique used for plated-through holes that determines hole-wall and surface-metal thicknesses, shows general topography and grain structure, and reveals presence of voids, starring, resin smears, and thermal and peripheral cracking.

crosstalk — Undesirable interference caused by the coupling of energy between signal paths.

cup terminal — A hollow, cylindrical solder-cup (pot) is a terminal that is designed to accommodate wires that are inserted into the opening without a mechanical wrap.

cure — To change the physical properties of a material by chemical reaction, by the action of heat and catalysts, alone or in combination with or without pressure.

current-carrying capacity — Under specified conditions, the maximum current carried continuously by a conductor without objectional degradation of the electrical or mechanical properties of the board.

cut and strip — A method of producing artwork by cutting the pattern and stripping away the unwanted areas of a two-layer system.

cyanate ester — TBD

D

datum reference — A defined point, line, or plane used to locate a pattern or layer for manufacturing and/or inspection purposes.

deburr-blast — Two machines coupled together for continuous deburring and mechanical cleaning of production panels.

deburring — Removing metal burrs and other extraneous matter from drilled holes.

decay time — The time between two specified values of a variable that decreases with time. The appropriate decay time parameter in three common areas is: (1) the half-life for nuclear decay processes; (2) the time constant for RC, RL, and RLS circuits; (3) the time for a charged material to reach 10 percent of its initial voltage after being grounded.

defect — A nonconforming imperfection that exceeds the limits of acceptance. At Digital, unacceptable defects are categorized as critical, major and minor (incidental defects are acceptable).

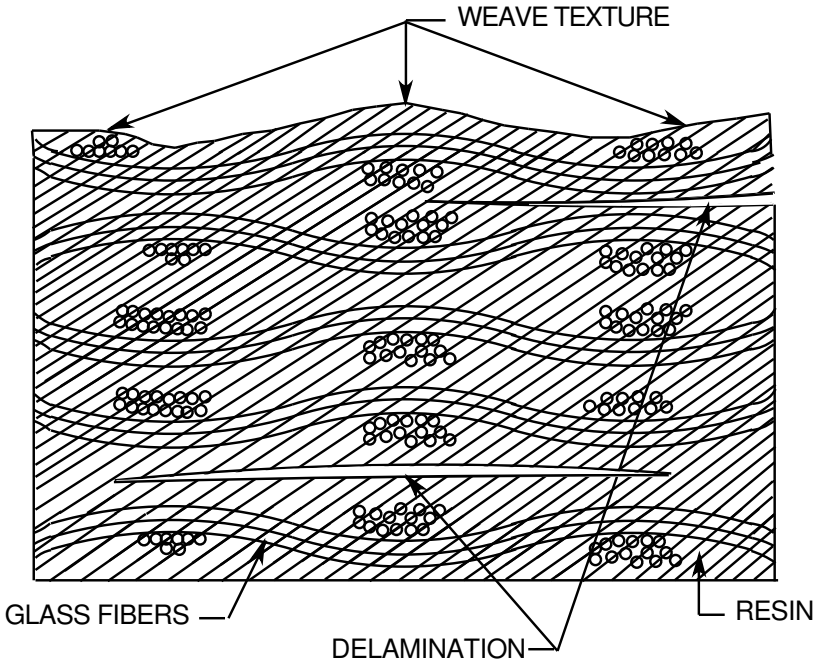
defect identification — The provisions for recording the coordinate location of each defect and characterizing the nature of the defect. This data will be suitable for use in manual/automated rework operations as well as statistical process control.

definition — The fidelity of pattern-edge reproduction on a board or panel relative to the artwork master.

degradation — A gradual deterioration in performance characteristics as a function of time.

delamination — Separation between the plies of the base material, between laminated base material and copper cladding, or between conductor layers in a multilayer board. See Figure 18.

Figure 18: Delamination



dendritic growth — The electrolytic transfer of metal from one conductor to another across a space/gap, similar to electroplating. Dendritic growth however usually grows from cathode to anode. The dendrite resembles a tree in appearance, and on touching the opposite conductor will provide an abrupt rise in current.

densitometer — An instrument for measuring the density of a photographic emulsion on film or glass.

density — In photography, a specific expression of the amount of silver deposited in a given area, in terms of the amount of light that will pass through it. Numerically, this density is the logarithm (base 10) of the reciprocal of the transparency expressed as a percentage. D-Max is a numeric expression of maximum density measured in the dark areas of a photographic image; D-Min is a numeric expression of minimum density measured in the clear areas of a photographic image.

dent — A depression in conductive foil or plating that does not decrease the thickness significantly, or a depression in a component that does not prevent the performance of its specified function.

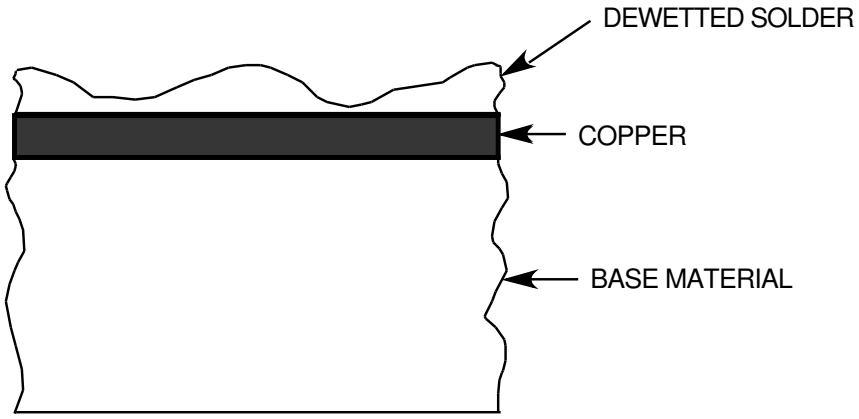
deposition — Use *electroless deposition*.

detaping — Removing the adhesive tape that protects printed wiring above the fingers in finger-stripping and finger-plating processes; occurs immediately after finger plating.

device — An individual element, usually in an independent body, that cannot lose any of its parts without destroying its specified function.

dewetting — Incomplete coverage by a liquid applied over the entire surface; characterized by droplets separated by unwet areas, or irregularly shaped mounds separated by a thin film in the case of molten solder. Use *nonwetting*. See Figure 19.

Figure 19: Dewetting



dielectric — A nonconductor of direct current.

dielectric absorption — The property of an imperfect dielectric whereby there is an accumulation of electric charges within the body of the material when it is placed in an electric field.

dielectric breakdown — A complete failure due to a sudden and large increase in current through an insulator, evidenced by a disruptive electrical discharge through the material.

dielectric constant — The property of a dielectric that determines the electrostatic energy stored per unit volume for a unit potential gradient. Actually the ratio of the capacitance (Cx) of a given configuration of electrodes with a specified dielectric, to the capacitance (Cv) of the same electrode configuration with vacuum or air as the dielectric.

dielectric loss — The time rate at which electric energy is transformed into heat in a dielectric when it is subjected to a changing electric field.

dielectric strength — The maximum voltage a dielectric can withstand under specified conditions without breaking down, usually expressed as volts per unit thickness.

dielectric withstanding voltage — Use HIPOT Test

digitizing — Any method of reducing locations on a flat plane to a digital representation of their x-y coordinates.

dimensional stability — A measure of dimensional change caused by temperature, humidity, chemical treatment, age or stress, usually expressed in relation to the original dimension (for example, in/in, mm/mm).

dimensioned hole — Located on a board by coordinate values not necessarily coinciding with the stated grid.

dip — Use *chemical solution*.

dip soldering — Solders the entire exposed conductive pattern and component leads in one operation by bringing boards into contact with the surface of a static pool of molten solder. Refer to *drag soldering* and *wave soldering*.

discharge — See *electrostatic discharge*.

discrete — A device used as a distinct and individual component and packaged as a stand-alone element. Diodes and small outline transistors (SOTs) are examples of discretes.

dissipation factor — A measure of alternating current loss (D) proportional to the power loss per cycle (f) per potential gradient (E, squared) per unit volume as follows.

$$D = \frac{power\ loss}{E^2 * f * volume * constant}$$

disturbed joint — The lead or part moved while the solder was solidifying; has a dull granular appearance and/or noticeable cracks.

dot plot — Use *hole pattern*.

double-ended board — Contains fingers on both (opposite) ends.

double-sided board — Copper foil or conductive pattern on both sides of the panel or board.

drag-in — Water or solution carried into a tank by panels and racks.

drag-out — Solution carried out of a tank by panels and racks.

drag soldering — Solders component leads to the conductive pattern by bringing moving boards into contact with the surface of a static pool of molten solder. Refer to *dip soldering* and *wave soldering*.

drawbridging — Use *tombstoning*.

drill and etch drawings — Engineering drawings that specify the conductive and nonconductive patterns on a printed-wiring board including any fingers and plated-through holes.

drilling — At Digital, an automated process that adds conductor connection holes, component mounting holes, and some tooling holes to panels.

dross — Oxide and other contaminants formed on the surface of molten solder.

dry-film printing — A phototransfer process that applies the image(s) of the conductive pattern to each panel.

dry-film soldermask — A photopolymer film added to the conductive pattern after final inspection to prevent bridging in the solder-wave (component assembly) process.

dry lab — A quality assurance and control laboratory where nonchemical process and product attributes are analyzed.

dual in-line package (DIP) — A rectangular plastic or ceramic package for intrusive mounting with two rows of metal leads along its longer edges.

DRAM (Dynamic RAM) — Read/write memory that must be refreshed (read or written into) periodically to maintain the storage or information.

E

edge-board connector — A connector designed specifically for making removable and reliable interconnections between the edge board contacts on the edge of a printed board and external wiring. Use *connector*.

edge-board contacts — A series of contacts printed on or near any edge of a printed board and intended for mating with an edge-board connector. Use *finger*.

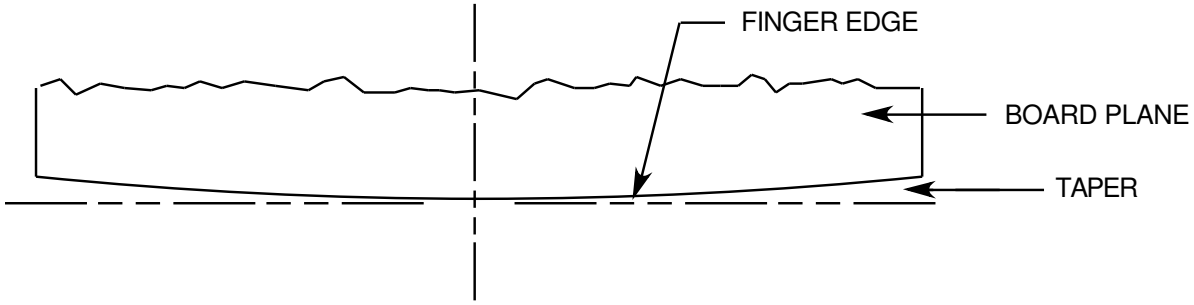
edge definition — Refer to *definition*.

edge fog — A cloudy or foggy effect resulting from light diffraction, sometimes found in pattern images at the edge of glass plates. Refer to *clouding*.

edge spacing — The distance of a pattern or component from the edge of a board. Refer to *margin*.

edge taper — The gradual tapering of the finger edge(s) of each hex board from the center that permits easier insertion of the fingers into an external connector. See Figure 20.

Figure 20: Edge Taper



edge-to-edge spacing — Use *conductor spacing*.

E-glass — A low-alkali lime-alumina-borosilicate glass fiber noted for its good electrical properties.

electrical overstress (EOS) — The electrical stressing of electronic components beyond their specifications. May be due to ESD.

electrical part — A part such as a microcircuit, discrete semiconductor, resistor, capacitor, thick or thin film device, or piezoelectric crystal.

electrical testing — Checking the electrical integrity of printed-wiring after final fabrication.

electrodeposited copper foil — Formed by the direct electrodeposition of copper onto a rotating head or drum from which it is continuously stripped.

electrodeposition — The deposition of a conductive material from a plating solution with the application of electrical current.

electroless deposition — The chemical deposition of conductive material from an autocatalytic solution without application of electrical current. At Digital, this additive process plates a conductive layer over a nonconductive base material prior to the electroplating of plated-through holes. See *electroless plating*.

electroless plating — A method of metal deposition that uses a chemical reducing agent present in a processing solution. The process is further characterized by the catalytic nature of the surface, which enables the metal to be plated to any thickness. Copper, gold, and nickel are the metals most commonly eletrolessly plated.

electrolytic deposition — Use *electrodeposition*.

electromagnetic interference (EMI) — Impairment of a desired electromagnetic signal by an electromagnetic disturbance.

electromigration — A defect mode characterized by the growth of electrically conductive paths under electrical bias in the presence of contamination and humidity. Refer to *dendritic growth*.

electromotive induction — The induced voltage on a conductor as the result of being subjected to an electrostatic field.

electrostatic charge — See *static electricity*.

electrostatic charge detector — Any device used to determine the presence of electrostatic charge.

electrostatic damage — Damage to a device from static electricity by either (1) discharge from a charged conductor, (2) electric field induction, or (3) self-discharge.

electrostatic discharge (ESD) — The transfer of electrostatic charge between bodies at different electrostatic potentials caused by direct contact or induced by an electrostatic field.

electrostatic discharge (ESD) protective clothing — Clothing specially designed or treated to prevent buildup of electrostatic charge. Some examples are virgin cotton, antistat treated garments, and various cloths with 1 or 0.5 percent stainless steel, carbonized, or other conductive threads.

electrostatic discharge (ESD) protective material — A material capable of one or more of the following: preventing the generation of static electricity, safely dissipating electrostatic charges over its surface or volume, or providing shielding from ESD spark discharge or electrostatic fields. ESD protective materials are sometimes classified in accordance with their surface resistivity as either conductive, static dissipative, or antistatic. See also *semi-insulator*.

electrostatic field — (1) A field emanating from a charged object in which another charge will experience a force. (2) A voltage gradient between an electrostatically charged surface and another surface at a different electrostatic potential.

electrostatic monitor — A broad range of equipment designed to actuate when the electrostatic field reaches a specified level. The monitor will actuate with some form of corrective measure; for example, set off an alarm or activate an air ionizer.

electrostatic potential — The potential difference between a point and an agreed-upon reference point; usually the reference point is at infinity. See also *electrostatic potential difference*.

electrostatic potential difference (between two points) — The scalar-product line integral of the electric field strength along any path from one point to another in an electric field, resulting from a distribution of static electric charges.

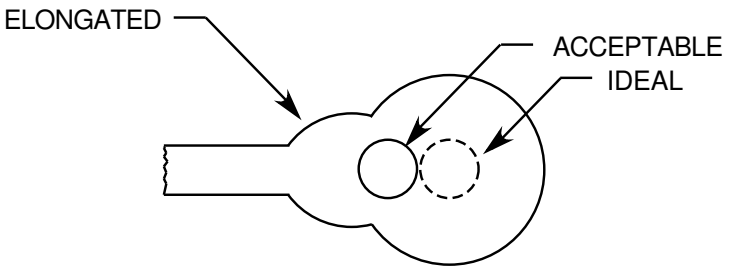
electrostatics — The study of the properties and behavior of discrete electrical charge at rest.

electrostatic shield — (1) An enclosure in which there is no electrostatic field. (2) A barrier that prevents the penetration of an electrostatic field. An electrostatic shield may not offer much protection against the effects of electromagnetic interference. EMI and RFS shields, however, are good electrostatic shields.

electrostatic shielding materials — Those materials that make an enclosure capable of attenuating an electrostatic field so that its effects do not reach the item stored or contained in the enclosure. See also *electrostatic shield*.

elongated pad — An optimized pad that reduces the incidence of hole breakout at the conductor-pad interface. See Figure 21.

Figure 21: Elongated Pad



emulsion — A homogeneous suspension of solid particles of very small size in a liquid or viscous medium. Photographically, the mixture of sensitive silver salts and gelatin in both wet and dry conditions.

emulsion side — Where the photosensitive coating is applied on a photographic film or plate.

engineering special feature — An artwork feature included within the confines of the finished board, a part of the design of the board (for example, fingers, handle holes, Digital logo).

epoxy — A polymer characterized by the presence of an epoxy group, which is a three-membered ring with two carbons and an oxygen molecule. Many epoxies use the slightly modified group with one additional carbon, known as the glicidyl group. In addition to being the site used for cross-linking, the epoxy group provides for good adhesion with the reinforcement. The aromatic (benzene) groups provide the stiffness, temperature stability, and other physical properties characteristic of epoxies. (Er = 3.8, Tg = 130°C)

epoxy smear — Use *resin smear*.

ESDS — ESD Susceptibility. A measure of the sensitivity of a device to ESD damage. An ESDS device is a device that is susceptible to failure from ESD. See also *ESDS device classification*.

ESD protective packaging — Packaging with ESD protective materials to prevent ESD damage to ESDS items. To be complete, ESD protective packaging requires the application of three separate and distinct principles: (1) equipotential bonding, (2) protection from triboelectric charging, and (3) Faraday cage shielding.

ESDS device classification — ESDS items are divided into classes based on their specific test failure voltages. Two different ESD susceptibility classification schemes exist, both using the same test circuit:

a. DOD-STD-1686/DOD-HDBK-263

Class 1	0 to $\leq$1000 volts
Class 2	$\geq$1000 to $\leq$4000 volts
Class 3	$\geq$4000 TO $\leq$15,000 volts

b. MIL-STD-883 Method 3015/MIL-M-38510

Category A	20 to 2000 volts
Category B	2001 volts and above

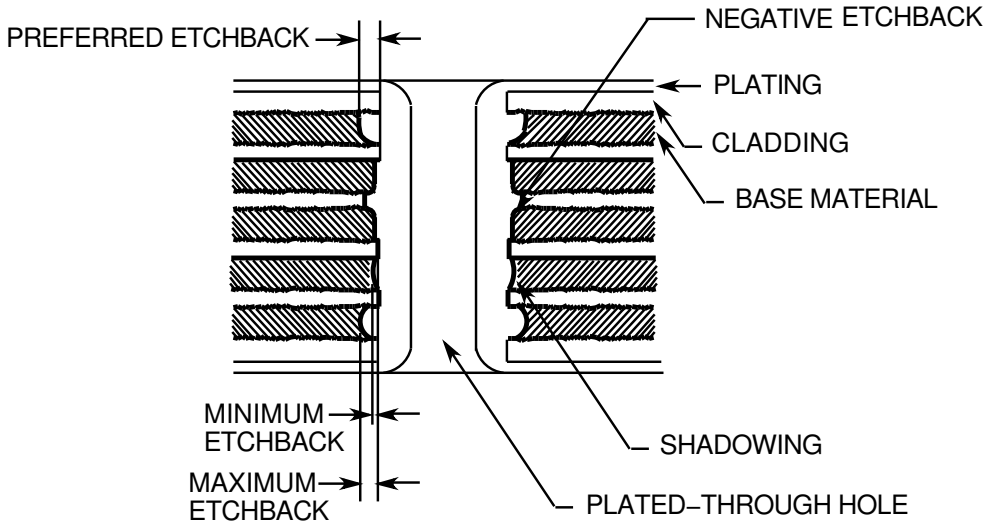
ESDS item — Electrical and electronic parts, assemblies, and equipment that are sensitive to ESD voltages of 15,000 V or less as determined by the Human ESD model in DOD-HDBK-263. ESDS items are further subdivided into ESDS device classifications.

etch — Most commonly used term when referring to *conductive* or *conductive pattern*.

etchant — A chemical solution that removes unwanted material from a panel or board.

etchback — Controlled chemical removal of all components of base material in hole walls in order to expose additional internal conductor areas. Refer to *chemical hole cleaning*. See Figure 22.

Figure 22: Etchback

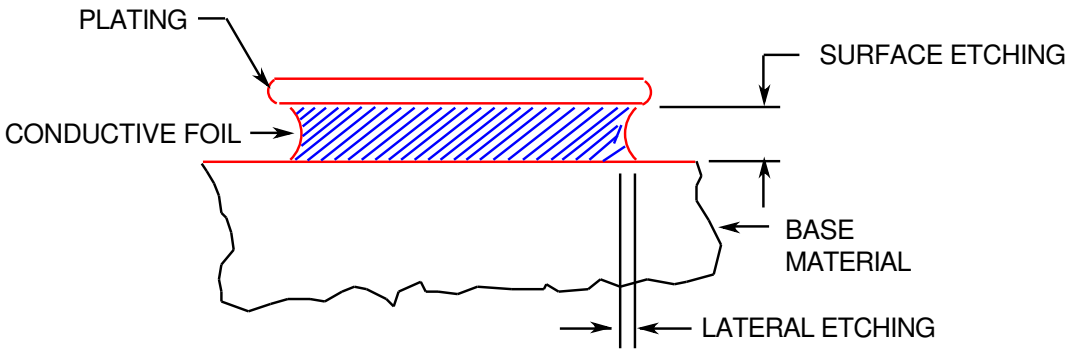


etch board — Use *printed-wiring board*.

etched printed board — The conductive pattern is formed by the chemical removal of unwanted portions of conductive foil. Refer to *subtractive process*.

etch factor — The ratio of the depth of surface etching (conductor minus plating thickness) to the amount of lateral etching (undercutting). See Figure 23.

Figure 23: Etch Factor

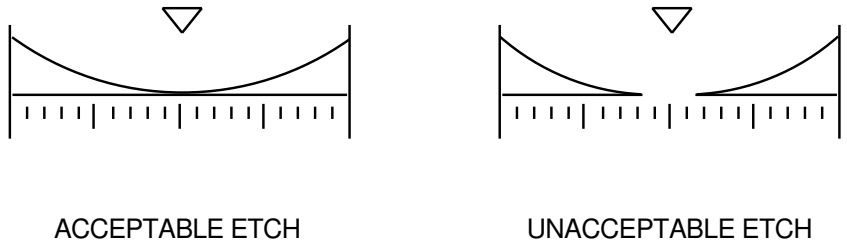


etching — Forms a pattern by the chemical or chemical and electrolytic removal of the unwanted portions of conductive material bonded to a base.

etching and stripping — A chemical process that removes the unwanted portions of conductive foil and then removes the resist material that protects the conductive pattern (wanted foil) on panels.

etching indicator — The wedge-shaped pattern or another specified pattern affixed to conductive foil to give a visual indication of etching quality. See Figure 24.

Figure 24: Etching Indicator



eutectic alloy — An alloy of metals so proportioned that all the metals in the alloy have a specific melting point rather than a range, thereby possessing the characteristic of passing from a liquid state to a solid without the intermediate plastic formation. Eutectic solder is by weight 63 percent tin and 37 percent lead.

expected release — Basic experimental capability demonstrated on evaluation coupons.

external layer — Use *outer layer*.

extraneous metal — Unwanted metal remaining on the base material after chemical processing.

eyelet — A hollow tube inserted and then formed in a board hole to provide electrical connection between conductor layers or mechanical support for a component lead. At Digital, eyelets are not acceptable for electrical connections in multilayer boards.

F

fabrication hole — Use *tooling hole*.

fabrication material — Copper-clad laminate, copper foil, prepreg, plating solution, or other material used in manufacturing printed wiring boards.

faraday cage shielding — A hollow conductive object useful for ESD protection because all external electrical fields and charges terminate or reside entirely on its outer surface. No net field is apparent inside the conductive object. One application is an ESD protective bag. See also *electrostatic shield*.

feature — A plotted or flashed pattern element on artwork (for example, pad, conductor, clearance hole, cross hairs). Refer to *special feature*.

feedthrough — See *interfacial connection/italic*.

feedthrough hole — A type of via hole that provides connection between the outermost layers of the finished printed-wiring board. Refer to *plated-through hole* or *via hole*.

few chip — A printed-wiring board with less than 10 active surface mount devices on side 1, and without passive devices. See *DEC STD 030-10 Module Manufacturing Standard - Footprint Design for Surface Mount Technology.*

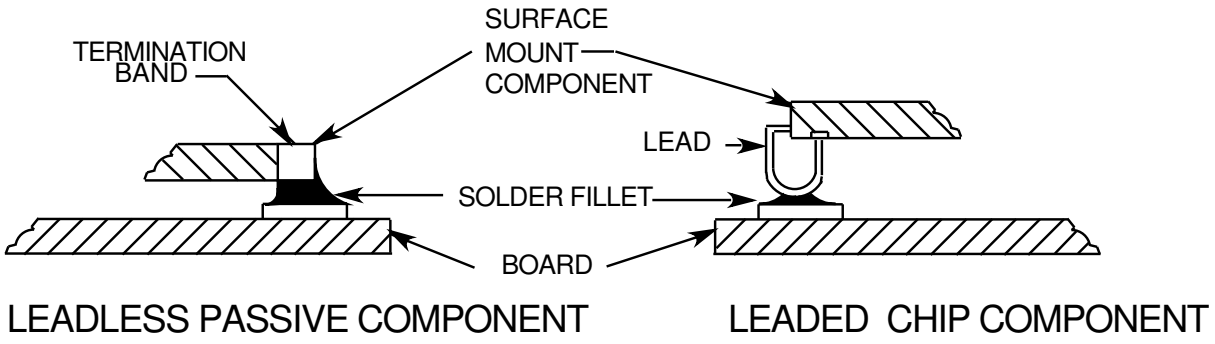
fiber exposure — Reinforcing fibers of the base material are exposed or protruding usually in machined, abraded or chemically treated areas. Refer to *weave exposure*.

fiducial — Reference points or targets on printed-wiring boards to allow vision-directed assembly systems to accurately locate boards or components onto boards.

fill — In base material, the threads of the reinforcing glass fabric that ran crosswise in the basic roll of fabric when it was woven and processed; also called woof. Fabric is usually not as strong in the fill direction as in the warp direction.

fillet — The concave junction formed by the solder between the footprint pad and the component lead. See Figure 25.

Figure 25: Fillet



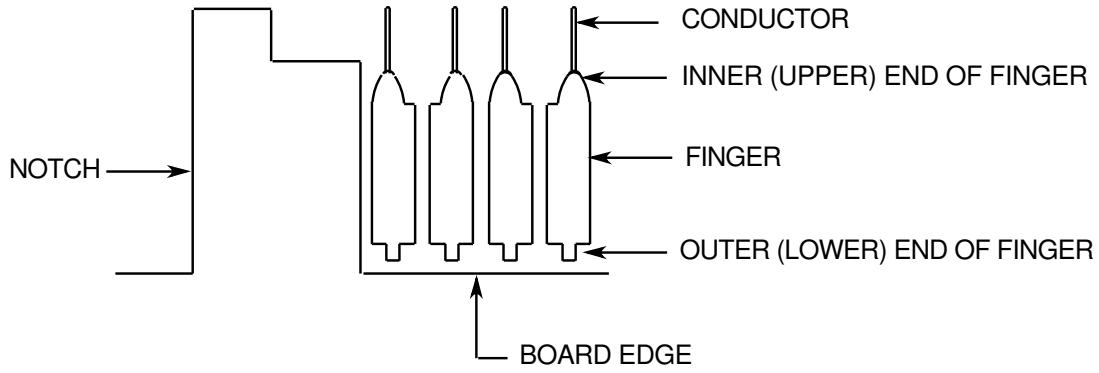
final fabrication — A board-shop process wherein panels become boards or multiple boards through appropriate punching, routing and beveling operations.

final inspection — Final examination of boards for visible imperfections.

fineline board — Nominal conductor widths and spacing are a maximum of 0.25 mm (0.010 inch) and nominal pad diameters vary in accordance with design requirements. In fineline-HD boards, nominal conductor widths and spacing are 0.20 mm (0.008 inch) with one conductor between pads. In fineline-H2D boards, nominal conductor widths and spacing are also 0.20 mm (0.008 inch), but there are two conductors between pads.

finger — A flat electrical contact, printed and then plated in the connector area on or near the edge of a board, that will mate with a respective contact in a connector to provide an external electrical connection. See *printed edge board contacts*. See Figure 26.

Figure 26: Finger



finger plating — The final electroplating process that adds two additional layers of metal (nickel and then gold) to the fingers to increase conductivity and durability. Refer to Figure 26.

finger stripping — Removes plated tin-lead resist from the fingers prior to finger electroplating.

first article — Use *first piece*.

first piece — A sample board fabricated prior to the start of production for the purpose of assuring that the manufacturer will meet or exceed all specified requirements. Refer to *test board*.

flammability — Measure of a material's ability to support combustion; UL requirement for product safety (UL94).

flash — An extremely thin layer of plated material.

flat cable — Two or more parallel conductors (round or flat) in the same plane and encapsulated by an insulating material.

flat cable connector — Type of cable that is soldered to the contacts of a particular printed-circuit board.

flat pack — A component package having its ribbon leads extending from its sides in a plane parallel to its base.

fleck — An imperfection appearing as a speck in a clear area of artwork.

flex attach — TBD

flexible lead tech — TBD

flexible printed-circuit/wiring board — Printed-wiring and components, or just printed-wiring, fabricated on or in flexible base material with or without flexible cover layers.

flexprint cable — Flexible circuitry with conductors separated by insulating material.

flexure failure — A conductor failure caused by repeated flexing, indicated by an increase of electrical resistance to a specified value for a specified time.

flow soldering — Use *wave soldering*.

flush board — The outer surface of the conductive pattern is in the same plane as the outer surface of the insulating base.

flush conductor — Conductor whose outer surface is in the same plane as the surface of the adjacent insulating material.

flux — A chemically active compound that promotes the wetting of metals with molten solder. When heated, flux will remove oxides but will not remove dirt, oils or fingerprints.

flux solder connection — A solder joint characterized by entrapped flux that often causes high electrical resistance.

foil — Refer to *conductive foil*.

footprint — The flat surface of the substrate pad required for mounting surface mountable components.

footprint library — A library of footprint patterns for various types of surface mount components for component mounting on a board. Refer to *DEC STD 030-10 Module Manufacturing Standard - Footprint Design for Surface Mount Technology*.

footprint pad — A surface mount pad to which a device is soldered.

fractured joint — A solder joint where the lead has separated from the solder connection more than 180 degrees on either side 1 or side 2 of the PTH. Also identified as a disturbed solder joint with a dull granular appearance and/or noticeable cracks.

from-to list — Wiring instructions in the form of a list indicating termination points.

full release — A fully-documented initial manufacturing release.

fully-additive process — The entire thickness of electrically-isolated conductors is built up by electroless metal deposition. See *fully-additive technology*.

fully-additive technology — A process that is used for obtaining conductive patterns through the selective deposition of conductive material on an unclad base layer. The unclad layer is typically catalysed to enhance the plating adhesion. Known within Digital as Full Build.

fully electroless — Use *fully-additive process*.

fused coating — A metallic coating (usually tin or solder alloy) that has been melted and solidified in order to form a metallurgical bond with the base metal. Refer to *infrared fusing*.

fusing — Refer to *infrared fusing*.

G

galvanic deposition — Use *electrodeposition*.

galvanic displacement — Refer to *immersion plating*.

gel time — The time, in seconds, required for a resin to change its physical state from a solid through a liquid to a solid again due to the action of thermal inputs.

glass — Fiberglass or woven fiberglass sheeting impregnated with epoxy resin or some other kind of resin. Refer to Figure 18.

glass transition temperature — Actually a narrow temperature range in which an amorphous polymer (or the amorphous regions in a partially crystalline polymer) changes from a hard and relatively brittle condition to a viscous or rubbery condition.

gold plating — Use *finger plating*.

graded wedge — Use *etching indicator*.

granular solder — Solder appearance with a coarse, large grain structure, lacking in metallic luster.

gray scale — A series of regularly spaced neutral color tones, ranging from clear to black through intermediate shades of gray, used as a reference scale for exposure control in photofabrication.

grid — An orthogonal network of two sets of parallel equidistant lines used for locating points on a board. (Note: Connections should be located on the cross-points of the gridlines. The position of conductors may be independent of the grid, that is, not necessarily following the gridlines.)

griplet — Use *eyelet*.

grommet — A rubber protector used to cover sharp edges of a hole through which conductors are run.

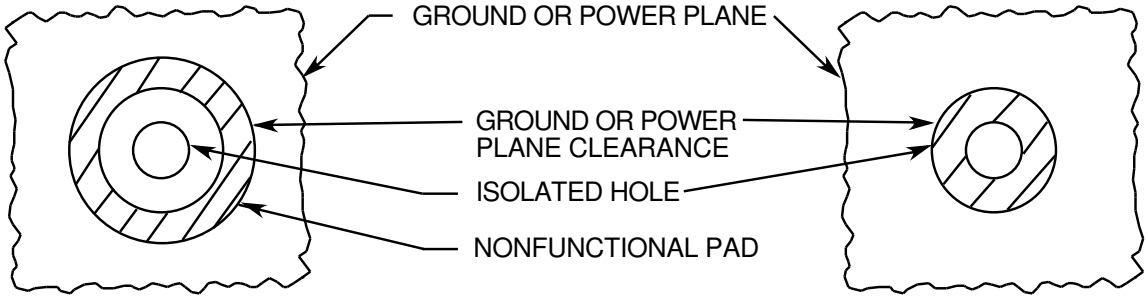
ground — A conducting path, intentional or accidental, between an electric circuit or equipment and the earth, or some conducting body serving in place of the earth. A reference point.

ground lug — A part used in connecting a wire to ground, and usually attached to the metal chassis or the component metal parts.

ground plane — A conductor layer or portion of same used for circuit returns, shielding, or heat sinking. Refer to *power plane*.

ground/power-plane clearance — A clearance hole in a ground or power plane that isolates the plane from a smaller hole in the adjacent base material. See Figure 27.

Figure 27: Ground/Power-Plane Clearance

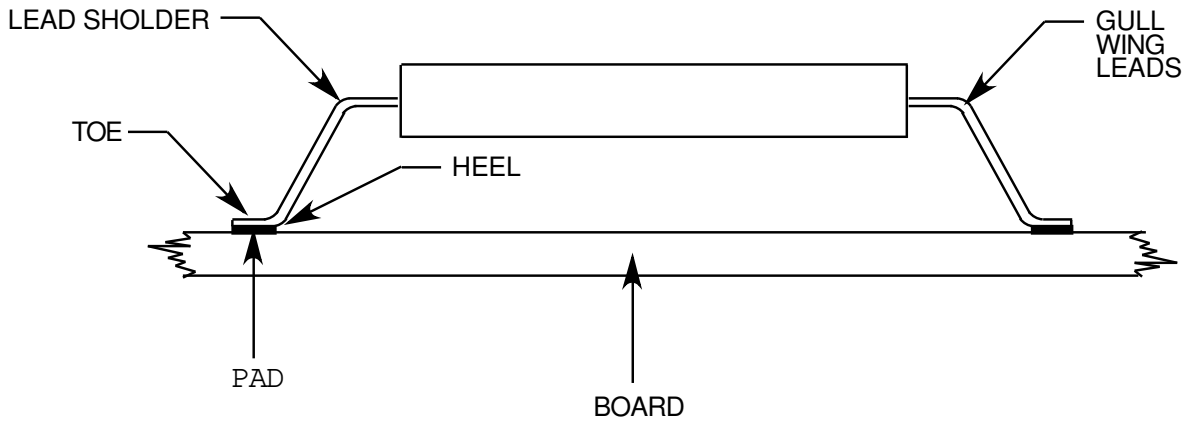


ground straps — A skin-contacting wrist, leg, or ankle strap that rapidly dissipates personnel static charges safely to ground and equalizes personnel static levels with that of the work surface. Strap should contain a current-limiting resistor for safety.

grounded work bench — Work bench surfaces connected to ground through a ground cable containing a current-limiting resistor for safety.

gull-wing lead — This lead exits the body of the component parallel to the bottom of the package, then forms a right angle bend, and finally another right angle bend. The bottom of the formed lead is parallel with the surface of the board lands. See Figure 28.

Figure 28: Gull-Wing Lead



H

haloing — Mechanically induced fracturing and/or delamination on or below the surface of base material; usually evidenced by a light area around a hole or other machined surface, may not become visible until after exposure to thermal stress.

hardware — 1. Electronic components, subassemblies, and finished pieces of equipment, as controlled by a drawing board design. 2. Bolts, nuts, fasteners, brackets, handles, and similar small structural parts used in assembling electronic equipment.

HD/50 — One conductor line between pads having vias of 1.27 mm (0.050 inch) centers.

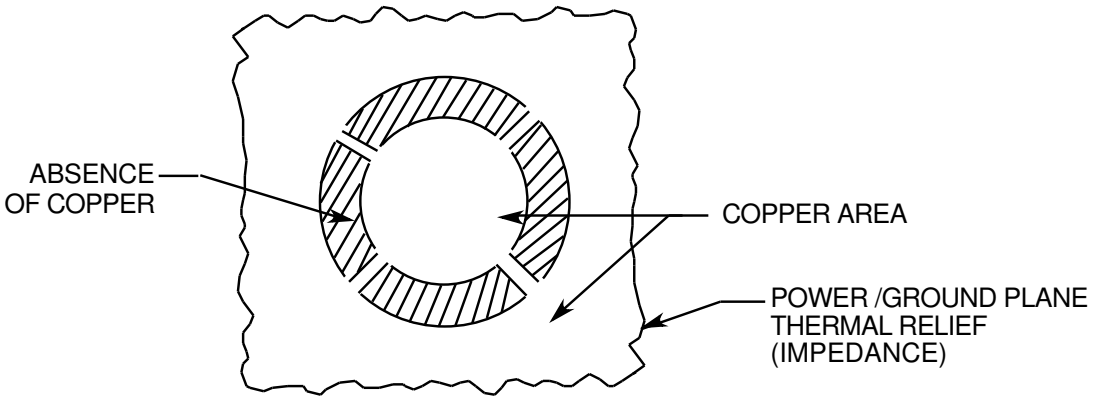
H2D/50 — Two conductor lines between pads having vias at 1.27 mm (0.050 inch) centers. Usual line/spacing of 0.127/0.127 mm (0.005/0.005 inch) with 0.508 mm (0.020 inch) pads.

H2D/100 — Two conductor lines between pads having through holes at 2.54 mm (0.100 inch) centers. Usual line/spacing of 0.1524/0.254 mm (0.006/0.010 inch) with 1.524 mm (0.060 inch) pads.

heat-relief configuration — As shown below, a particular arrangement of conductors (and clearance areas) forming an annular ring that connects a plated-through hole to a power/ground plane or heat-sink area. Minimizes the heat required to solder and desolder connections to the plated-through hole.

heat sink — An enlarged pad that dissipates heat away from heat-sensitive components. Refer to *ground plane* or *power plane*. See Figure 29.

Figure 29: Heat Sink



heat sink (component) — A formed metal structure that dissipates heat to the air or other sinks.

heel grounders — See conductive footwear.

height — For a printed-wiring board, refer to *length*.

hex board — Located on one or both sides of a standard board, contains 6 sets of fingers along one board edge; may contain up to 12 sets per board with 6 sets along one edge and the remaining set(s) along the opposite edge. Refer to *quad board*.

high-density board — Nominal conductor widths and spacing are a maximum of 0.38 mm (0.015 inch) and nominal pad diameters a maximum of 1.40 mm (0.055 inch) with one conductor between pads; in a high-density backplane board, nominal pad diameters are a minimum of 1.91 mm (0.075 inch).

high density signal carrier (HDSC) — A thin film interconnect structure that includes both high density signal and power cores, which are insulated from each layer by polyimide film. Signals are connected layer to layer within a core by "posts" or PTH (vias) within that core or layer.

high performance tape package (HPTP) — An interconnect package that includes flexible leads on a very fine pitch density (12.5 mils). The package incorporates fine pitch (TAB) bonding to the chip (inner lead bonding [ILB]) and package (outer lead bonding [OLB]) to produce a dense interconnect structure that is subsequently bonded to the PWB surface. See *tape automated bonding*.

HIPOT test — Test that measures the printed-wiring board internal structures (signal /ground) for voids within the internal dielectric layers using high voltage.

holding tank — Contains acid or alkaline solution that must be treated by waste treatment personnel prior to disposal.

hole — Refer to *access hole, blow hole, clearance hole, component hole, dimensioned hole, interstitial via-hole, locating feature, pinhole, plated-through hole, supported hole, tooling hole, unsupported hole* or *via hole*.

hole breakout — Refer to *breakout*.

hole cleaning — Use *chemical hole cleaning*.

hole count/density — The quantity of holes in a board per unit area.

hole location — The dimensional location of the center of a hole.

hole pattern — The arrangement of all holes in a board.

hole pull strength — The force necessary to rupture a plated-through hole when loaded or pulled in the direction of its axis.

hole void — A void in the metallic deposit of a plated-through hole exposing the base material.

holewall pullaway — A condition that exists within the plated-through hole (PTH), whereby the barrel wall has moved away from the resin, thereby leaving a void. The barrel wall exhibits a "bowing away", which differs from the phenomenon visible with resin recession (resin recedes from barrel).

hook terminal — A terminal formed in a hook shape; it is generally found on sealed relays.

hot air reflow — A machine that directs hot air onto the solder paste and lead, melting the paste and creating a solder joint. This method is often used in manual assembly and/or rework and repair operations.

CAUTION

Do not use on PLCCs.

hot air solder leveling (HASL) — A printed-wiring board fabrication process whereby the board is completely covered (dipped) with molten solder, and the excess is blown off with high pressure air.

hull cell — An analytical tool used in predicting the effects of current densities and chemical constituents in electroplating operations.

hydrosqueegee — The trade name for a reflow process that sprays hot oil on solder plated boards in order to melt and reduce the thickness of the solder. Usually not acceptable in the fabrication of Digital printed-wiring boards.

I

icicle — Use *solder projection*.

image — The conductive pattern on photographic artwork.

image transfer — The application of images or reverse images of conductive patterns to panels using a screen or dry-film printing process.

immersion plating — The chemical deposition of a thin metallic coating over a basis metal by a partial galvanic displacement of the metal.

impedance — See *controlled impedance*.

incidental defect — A defect in a product, that judgment and experience indicate will meet reliable standards of operation (form, fit, or function), but may depart from established standards and have little bearing on the effective use or operation of the unit/assembly/system.

inclusion — A metallic or nonmetallic foreign particle embedded or entrapped in plating, conductive foil, or base material. See Figure 11.

indentation — Use either *dent* or *pit*.

indexing hole/mark/notch/slot — Refer to *locating feature*; use either *tooling hole, register mark, notch* or *slot*.

inductive charging — See *field-induced model*.

infrared fusing — A melting and solidification process that forms solder from tin-lead plating, spreads this plated metal more evenly over the basis metal, and forms a metallurgical bond to increase the durability of the plated metal.

infrared reflow (IR) machine — An oven, usually with a conveyer belt, that heats the solder paste to drive off the volatiles and, therefore, dry the paste.

initiating — Use *activating*.

ink — Use *resist*.

inner layer — A conductor layer or two adjacent conductor layers and associated base material inside a board; actually, a single- or double-sided print-and-etch board (without fingers) on the inside of a multilayer board.

inspection lot — A unique collection of product units from which a random sample is drawn and inspected to determine the product's conformance with acceptability criteria.

inspection overlay — A positive or negative transparency made from the production master and used as an inspection aid.

insufficient solder — The quantity of solder in the solder joint that results in the inability of the solder joint to withstand the mechanical and thermal stress applied during product life.

insulated — Separated from other conducting surfaces by a dielectric, offering a high resistance to the passage of current to disruptive discharge.

insulation — Nonconductive material used as a means of separating conductive surfaces offering a high resistance to the passage of current.

insulation damage (thermal) — Insulation material that is charred, burned, or melted away after soldering.

insulation resistance — Under specified conditions, the electrical resistance of the insulating material between any pair of conductors, fingers, pads, conductor layers, or plated-through hole barrels, or between any combination of two of these items.

insulative material — A material having a surface resistivity of at least 1×10^{13} ohms/square, or 1×10^{11} ohms-cms volume resistivity. A nonhomogeneous (that is, coated) material, can be surface-conductive but volume-insulative.

integrated circuit (IC) — A device in which all of the components of an electronic circuit are fabricated on a single piece of semiconductor material, often called a chip, which is placed in a plastic or metal package with terminals for external connection.

interfacial connection — An electrical connection between conductive patterns on parallel layers of the circuitry. (May be an eyelet, or plated-through hole (PTH) but may not contain a component lead.) Use *through connection*.

interlayer connection — Provides electrical continuity between conductive patterns in different inner and/or outer layers of a multilayer board. Refer to *through connection*.

internal layer — A conductive pattern that is contained entirely within a multilayer printed board. Use *inner layer*.

interposers — An interconnect system that operates in the z-axis plane and acts as a connection medium between the chip/board, package/board and module/board.

interstitial via hole — A plated-through hole connecting two or more conductor layers in a multilayer board but not extending through all the layers of base material in the board. Refer to *blind via* and *buried via*.

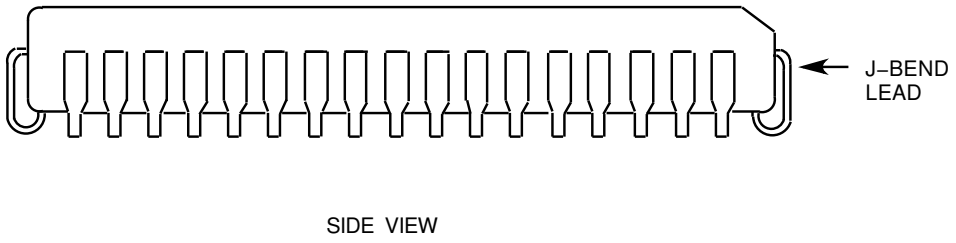
intrusive hole — Plated-through holes for component lead insertion.

ionizable (ionic) contaminants — Process residues such as flux activators, fingerprints, etching and plating salts, that exist as ions and when dissolved increase electrical conductivity.

J

J-bend lead — A lead that exits the body of a component and then bends down the side and under the body of the component package, forming a capital J. See Figure 30.

Figure 30: J-Bend Lead



J lead — Refer to *J-Bend lead*.

joint inspection rate — The number of joints/second the machine can inspect at the user-specified false alarm and escape rate settings.

junction burnout — A failure mode caused by the injection of an electrical transient of sufficient magnitude and duration to initiate second breakdown and subsequently to melt the junction.

jumper — A direct electrical connection between two points on a printed board added after the printed-wiring is fabricated. (A jumper consists of bus wires.)

jumper wire — A wire used as a jumper.

K

key — Any device that ensures the proper coupling of two components. Refer to *locating feature*.

keying slot — A slot in a board that allows it to be inserted into its mating receptacle but prevents it from being inserted into any other receptacle. Refer to *polarizing slot.*

keyway — Use either *keying slot* or *polarizing slot*.

kitting — A series of manual and mechanical operations (a process) that mates the process sheet and tapes with the correct number of panels, pins the panels together in drilling stacks, and sends the pinned stacks to drilling in tote boxes.

L

laminate — A product made by bonding together two or more layers of material (for example, a fiberglass sheet impregnated with resin and covered on one or both sides with copper foil).

laminated-blind via (LBV) — A via structure that extends from one surface to the midpoint of a symmetric lay-up. A board suitable for laminated-blind via construction must have at least two signal layers associated with each half of the board, and two pad layers.

laminated stencil — A laminated or stepped stencil used for applying solderpaste.

laminate thickness — A measurement from one surface to the opposite including base material and copper foil, prior to any processing. Refer to *board thickness*.

laminate voids — TBD

lamination — Bonding two or more layers of material together by using heat and pressure.

land — Synonymous with *annular ring, pad*, or *terminal area*.

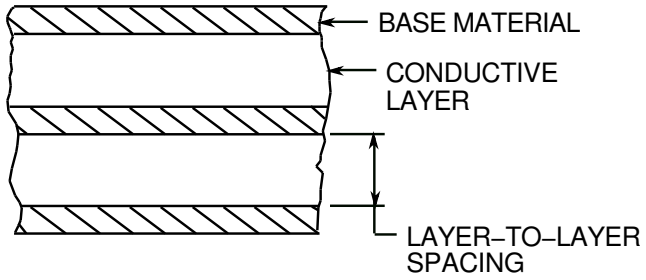
landless hole — Use *padless hole*.

latent ESD failure — A time-dependent failure that occurs under use conditions because of earlier exposure to an electrostatic discharge that did not result in an immediately detectable defect condition.

layer — Either a conductor layer, a conductor layer and its base material, or two adjacent conductor layers plus the intervening base material and through connections (if any).

layer-to-layer spacing — The thickness of dielectric material between adjacent conductor layers in a multilayer board. See Figure 31.

Figure 31: Layer-to-Layer Spacing



lay-up — A manual multilayer operation wherein copper-foil and prepreg sheets and inner layer boards are arranged and pinned together in stacks for lamination.

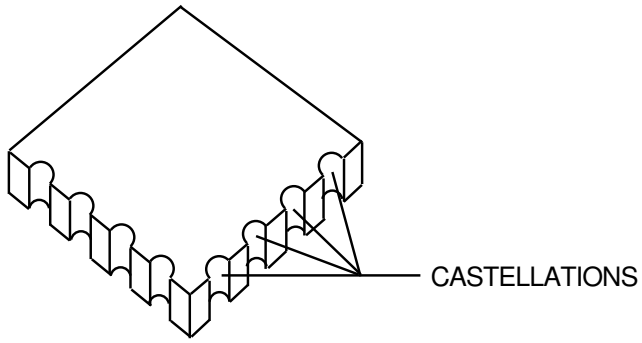
lead — A length of conductor used to interconnect terminal points.

leaded chip carrier(LDCC) — A chip carrier whose external connections consist of leads extending from its sides at right angles to a plane parallel to its base.

leadless ceramic chip carrier (LCCC) — A package in which an integrated circuit chip can be mounted to form a surface-mounted component. It is made of a ceramic material that can withstand high temperatures and can be hermetically sealed. It does not have leads, but has pads around the perimeter for connection to a printed-wiring board footprint.

leadless chip carrier (LCC) — A ceramic leadless package for semiconductor dies. Use of LCC devices on Digital products is discouraged. Refer to *DEC STD 030-9 Module Manufacturing Standard - Surface Mount Technology Design Rules* for additional information. See Figure 32.

Figure 32: Leadless Chip Carrier (LCC)



lead-mounting hole — Use *component hole*.

lead peel back — A solder joint that exhibits good wetting characteristics, where the lead has been mechanically separated by not more than 180 degrees, or half the circumference of the lead. For lead peel back, the lead must show evidence of being manually cut.

lead projection — Component lead protrusion from the side of the board opposite the component.

learn time — The time required to do the initial programming ("teaching") to store the coordinate location and other data for each solder joint in machine memory.

legend — Letters, numbers or other symbols on a board stating a part number, component location, company name, and so forth. Refer to *roadmap*.

leg strap — See *ground straps*.

length — On a printed-wiring board, length is measured perpendicular to the fingers or finger edge.

lifted conductor — Refer to *delamination*.

limited release — Process capability released to controlled users for prototype or low-volume applications.

line — Use *conductor*.

liquid photoimageable soldermask — A liquid resin based UV-imageable thermal-cured mask, which can be applied by curtain coat, roller coat or flood screen coat. The applied mask is then tack dried by thermal bake. The dried film is then exposed, developed and thermally cured to assure product functionality.

load factor — The number of panels normally fed into a process machine at one time.

load time — The time required to load the next test sample into the machine and initiate the test.

locating feature — Mark, hole, notch or slot in a panel or board used to position it accurately in a particular process, operation or mating connector.

logic diagram — An engineering drawing that depicts the multistate device implementation of logic functions with appropriate symbols and supplementary notations, showing details of signal flow and control but not necessarily point-to-point wiring.

lot — A collection of product units bearing appropriate identification and treated as a unique entity in all manufacturing processes. Refer to *inspection lot*.

lug — A metal device of various sizes, either soldered or crimped onto the end of a conductor. The lug is a mechanical means of making an electrical connection at a terminal or terminal strip.

M

machine-loading factor — The amount of time lost as a result of moving panels through a process machine.

macrostructure — The structure of metal revealed by examining a polished specimen at a magnification no greater than 10 diameters.

major defect — A major defect, other than critical, that results in failure, or reduces, mechanically or electrically, the usability of the unit/assembly/system for its intended purposes (the unit will or does fail for either form, fit, or function).

manufacturing hole — Use *tooling hole*.

manufacturing process documentation — Contains technical information unique to manufacturing that is not found in the engineering definition of the product. It supplements engineering documentation by providing detailed information concerning the materials, processes and inspections that are necessary for cost-effective implementation of engineering requirements.

manufacturing special feature — On panels and artwork outside the confines of the finished board, aids in tooling and manufacturing; sometimes called board feature or panel feature (for example, plating bar, insertion and re-zeroing holes, multilayer test pattern.)

margin — The distance between the reference edge of a flat cable and the nearest edge of the first conductor. Refer to *edge spacing*.

marking — Refer to *legend*.

mask — Refer to *resist*.

master artwork — Use *artwork master*.

master dot pattern — Use *hole pattern*.

master drawing — Actually a series of different drawings showing the dimensional limits and/or grid locations of all parts of a board, including the arrangement of conductive and nonconductive patterns, the size, type and location of holes, the placement of components, and any other information necessary to describe the final product. For a Digital printed-wiring board, the so-called master drawing comprises the board/panel data drawing, the drill and etch drawings, and additional fabrication data located in computer storage. For a printed-circuit board, the master drawing also comprises the parts list and unit assembly drawing.

master line — Use *conductor design width*.

master pattern — Use *production master*.

maximum area diameter — The maximum unpierced conductor (or plane) area of a printed-wiring board judged by the diameter of the largest circle that can be inscribed within the pattern.

maximum conductor thickness — The maximum thickness of copper conductors. For outer layers, the maximum thickness includes all plating. For inner layers, the maximum thickness is the base foil thickness.

maximum operating temperature — The maximum continuous use temperature that the printed-wiring board may be exposed to under normal operating conditions.

maximum solder limit temperature — Unless specifically designed for hand and dwell time soldering, each printed-wiring board construction is assigned a maximum temperature and dwell time. The tabulated levels are the maximum temperature and cumulative time conditions to which the PWBs may be subjected to during mass soldering of components.

mean time between failures (MTBF) — The average time between failures of a continuously operating device, circuit, or system.

measling — In fiberglass base material, an unconnected pattern of small irregular spots, crosses, squares or rectangles that appear to be white or at least lighter in color; caused by thermal stress, indicates separation of fibers in the glass cloth at weave intersections. See Figure 14.

mechanical wrap — The securing of a wire or lead snugly around a terminal/lug prior to soldering.

mechanically securing — Holding a component in place by a mechanical means, such that the component leads are not the exclusive means of support.

metal electrical face (MELF) — A surface mount microminiature leadless device (chip package) in a tubular shape.

memory board — A printed-wiring board assembly that contains mostly IC memory devices and their associated control circuitry.

meniscus — Component coating that has run down the component lead.

metal foil — Use *conductive foil*.

metallic film laminate bags — ESD protective bags of a sandwich-type construction, composed of various separate layers bonded together. The inside surface is usually an antistat impregnated plastic, and another layer is a thin metallic coating. These bags are designed to provide protection against both triboelectric charging and external electrostatic fields.

metallization — A deposited or plated thin metallic film used for its protective or electrical properties.

microetching — A chemical cleaning operation that removes organics, oxides, and other surface contaminants in order to produce virgin metal for a subsequent deposition or plating operation.

micrograph — A graphic reproduction of the surface of a prepared specimen, usually etched, at a magnification greater than 10 diameters. In Digital printed-wiring manufacturing facilities, photographic reproductions are used for inspection purposes.

microsectioning — Preparation of a board or panel specimen for a microscopic examination, usually by cutting out a cross section and then encapsulating, polishing, etching and staining it. In a Digital printed wiring manufacturing facility, both the preparation and the subsequent cross sectional analysis take place in the dry lab.

microstrip — A transmission line configuration consisting of a conductor over a parallel ground plane, separated by a dielectric.

microstructure — The structure of metal revealed by a microscopic examination of a polished and etched specimen at a magnification greater than 10 diameters.

micro vias — Vias of 0.1524 mm (0.006 inch) diameter as formed. The technology is not currently available within the scope of these surface mount technology (SMT) versions.

minimum annular ring — At the narrowest point, the minimum width of metal between the outer edge of the pad and the edge of the drilled hole (inner layers of multilayer boards) or hole plating (outer layers of multilayer and other double-sided boards).

minimum base material thickness — The minimum thickness of the laminate (or lamination) for the finished printed-wiring board.

minimum cladding conductor thickness — The minimum metallic cladding (foil) thickness of the conductor.

minimum edge conductor width — Per Underwriters Laboratories UL-796, the minimum width of any conductor parallel with and spaced not more than 0.381 mm (0.015 inch) from the circuit edge.

minimum electrical spacing — The distance between adjacent conductors that is sufficient to prevent dielectric breakdown and/or corona between the conductors at any given voltage and altitude.

mini vias — Vias of 0.3302 mm (0.013 inch) diameter as formed in a 0.6350 mm (0.025 inch) diameter pad. The 0.3302 mm (0.013 inch) hole, after plating, has a diameter on the order of 0.254 mm (0.010 inch).

minor defect — A defect that judgment and experience indicate may, can, or will cause a form, fit, or functional failure. Rework of this condition is not necessary if the customer agrees.

mixed-mount assembly — A mixture of surface-mounted components and through-hole components on a module. The surface mounted devices (SMDs) are inserted and can be mounted on one or both sides of the board. The plated-through hole components are onserted and can be mounted only on side 1.

modification — The revision of the functional capability of a product to satisfy new acceptance criteria.

module/module assembly — A printed-circuit board with components attached, used primarily to interconnect various types and configurations of components to make a functional device. Within Digital, "module" is a synonym for printed-circuit board.

mother board — A printed-wiring board that interconnects arrays of plug-in electronic modules (daughter boards), mounted perpendicular or parallel to the mother board, using male and female pin-connector assemblies; it may or may not be in the backplane.

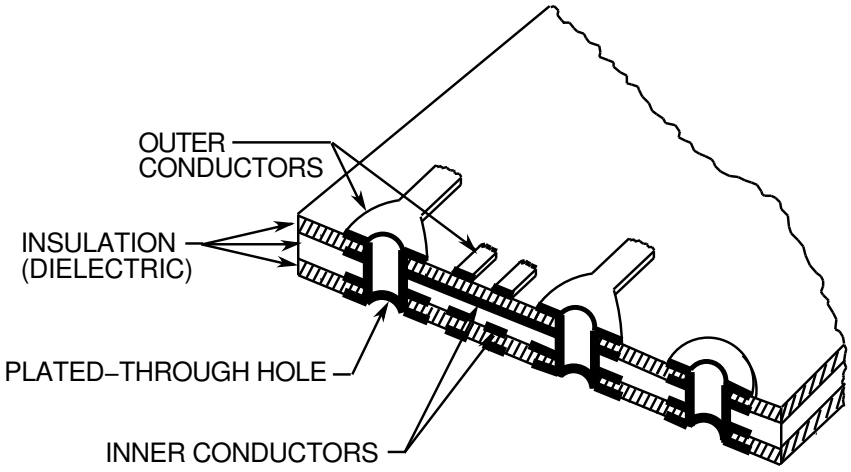
mottling — A minor amount of foil treatment transfer in the form of small irregular circles (rings) and/or larger blotches (irregular dots or spots) that are mostly white and may have yellow or brown shading.

mounting hole — A hole used for the mechanical mounting of a printed board to the chassis or for mechanical attachment of components to the board. (Also referred to as the access hole.)

multichip unit (MCU) — An assembly of highly integrated components consisting of substrates, chips, signal connectors, power contacts and flex cables. The MCU assembly houses the HDSC, CPU and SCU as part of its high performance module.

multilayer board — A printed-circuit board consisting of two outer layers of circuitry and at least one additional conductive layer in between the outer layers. See Figure 33.

Figure 33: Multilayer Board



multilayer printed-circuit — Refer to *printed- circuit*.

multilayer printed-circuit assembly — A multilayer printed-wiring board on which separately manufactured components and parts have been added.

multilayer printed-circuit board — Refer to *printed-circuit board*.

multilayer printed-wiring — Refer to *printed-wiring*.

multilayer printed-wiring board — Refer to *printed-wiring board*.

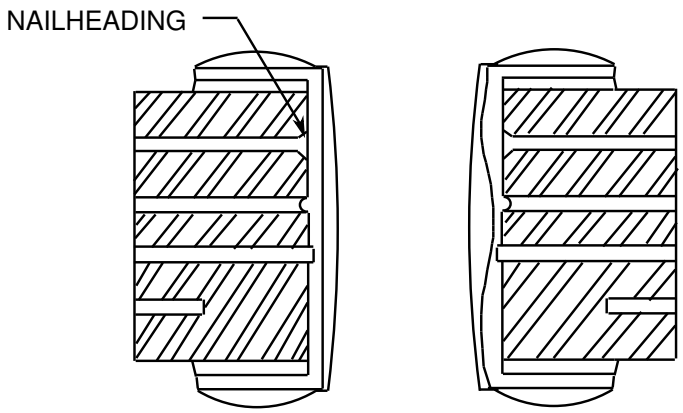
multiple-image production master — Refer to *production master*.

multisignal-layer board — A multilayer board greater than four layers total or more than two signal layers.

N

nailheading — A flaring of metal on the edges of inner conductor layers in a multilayer board, caused by improper hole drilling. See Figure 34.

Figure 34: Nailheading



negative — Artwork copy, artwork master, or production master in which the conductive pattern is transparent and the nonconductive pattern is opaque.

negative-acting resist — Polymerized (hardened) by light; after exposure and development remains on laminate surface areas that were under the transparent parts of the production master.

negative etchback — Inner conductor material is recessed in relation to surrounding base material in a multilayer board hole. See Figure 22.

nick — An imperfection appearing as an indentation in the edge of a photographic image; also designates a particular conductor imperfection.

nicked — Cross-sectional area of wire that is reduced by 25 percent.

nominal dimension — Either a *basic dimension* or a *reference dimension*.

nonconductive pattern — The configuration of functional nonconductive material (dielectric, resist, and so forth) surrounding the conductive pattern.

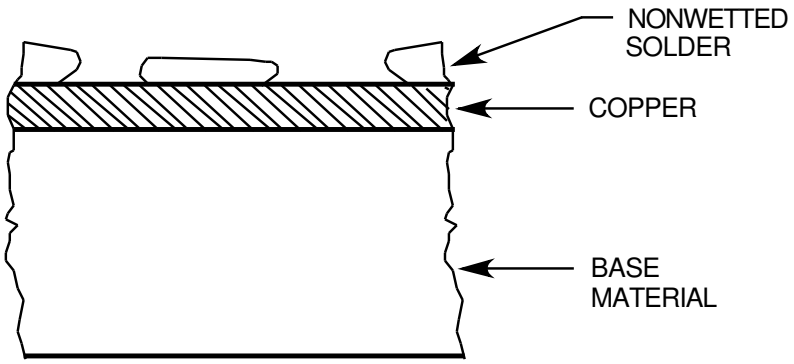
nonfunctional land — Use *nonfunctional pad*.

nonfunctional pad — Not connected to the conductive pattern on its layer, found on inner and outer layers of a board.

nonpolar solvent — Not ionized sufficiently to be electrically conductive; cannot dissolve polar compounds such as inorganic salts but can dissolve nonpolar compounds such as hydrocarbons and resins.

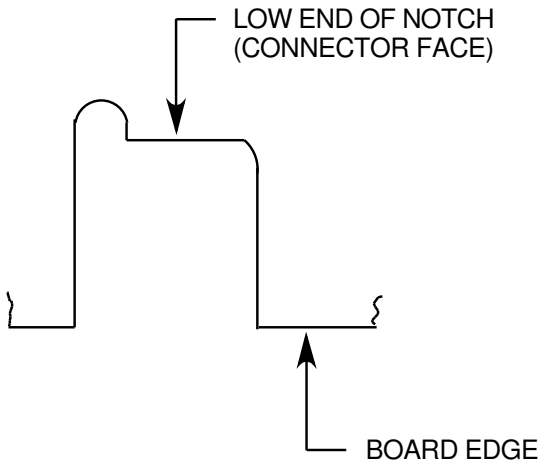
nonwetting — Occurs when molten solder or another liquid contacts a surface but does not adhere to it. See Figure 35.

Figure 35: Nonwetting



notch — A locating feature on the edge of a board that enables the accurate positioning of an external connector. See Figure 36.

Figure 36: Notch



number of clad sides — Indicates whether circuits have a conductive pattern on one (single-sided) or both (double-sided) sides.

O

offset pad — Not in physical contact with its component hole. Refer to *elongated pad*.

Ohms per square — An electronic measurement of surface resistivity across a given area. It is the measurement of the opposition to the movement of electrons where the electrons can take multiple paths across a uniform surface or through a material with a uniform cross section.

onsertion — The placement of a surface mount device on the printed-wiring board.

one-sided — Use *single-sided*.

opaquer — When added to resin, renders the base laminate sufficiently opaque so that the yarn or weave of the reinforcing material cannot be seen with the unaided eye using reflected or transmitted light.

open solder connection — The lack of electrical connection due to insufficient solder, coplanarity error, lead misalignment, or contamination, for example.

operation — A chemical, mechanical or manual function performed in a major process, or a minor ancillary process.

optimized pad — Use *elongated pad*.

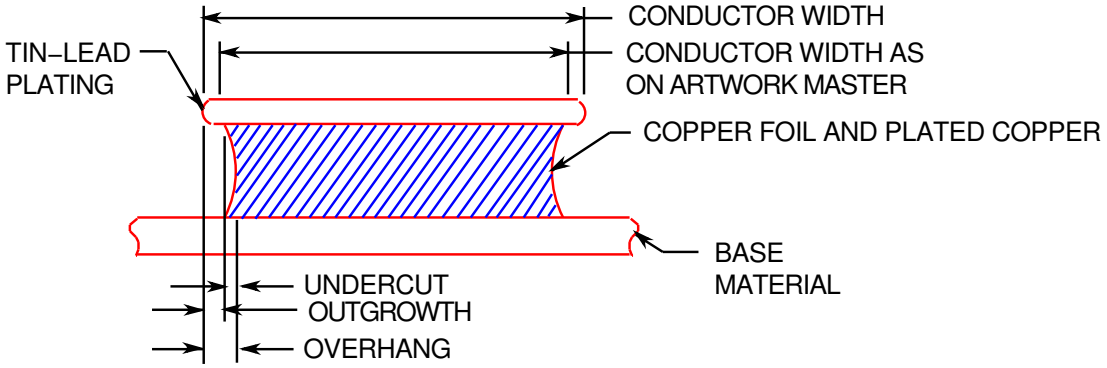
outer layer — A conductive pattern and its base material on the outside of a multilayer board.

outgassing — De-aeration or other gaseous emission from a panel, board, component or connector, caused by heat and/or pressure reduction.

outgrowth — The increase in width along the top edges of a plated conductor, caused by deposition or plating buildup beyond the limits delineated on the artwork master. See Figure 23 and Figure 37.

overhang — The sum of undercut plus outgrowth along the edges of a plated conductor; with no undercut, overhang equals outgrowth. See Figure 37.

Figure 37: Overhang



overshoot — When the plotted line overruns its specified termination or turning point and is visible on the developed artwork. The net effect is a decrease in conductor spacing or a complete short.

oxidation — A form of contamination that prevents proper solder wetting.

oxide transfer — Refer to *treatment transfer*.

P

package envelope — The outline of the entire body and lead extreme with the exception of the horizontal portion of the gull-wing lead. Refer to DEC STD 030-9.

packaging density — Quantity of functions (components, interconnection devices, mechanical devices) per unit volume, usually expressed in qualitative terms such as high, medium or low.

packaging styles — See specific entry for definition;

ADS — archive data structure
CLCC — ceramic leaded chip carrier
LCCC — leadless ceramic chip carrier
LDCC — leaded chip carrier
MELF — metal electric face
PLCC — plastic leaded chip carrier
PGA — pin grid array
PQFP — plastic quad flat pack
SMPGA — surface-mount pin grid array
SOIC — small outline integrated circuit
SOJ — small outline J-leaded package
SOT — small outline transistor
ZIF — zero insertion force
ZIP — zigzag in-line package

pad — An enlarged portion of the conductive pattern, usually placed at the end of a conductor, that provides for electrical connection and/or component attachment and may also be used as a heat sink or power or ground plane. Refer to *annular ring*.

pad only layer — Outermost layer of a printed-wiring board having only pads and no other functional interconnecting etch. The purpose of the pad only layer approach is to eliminate the potential for assembly solder bridging between high density surface etch features.

padless hole — A plated-through hole without pads or annular rings.

panel — Precut base material or copper-clad laminate on which the printed-wiring board is formed as a result of passing successively through all applicable manufacturing processes. More than one board may be fabricated on a panel.

panel plating — The plating of the entire surface of a panel including holes.

partial-additive technology — An alternative method of obtaining conductive patterns through selective deposition. This process requires the base material to have a layer of foil material as opposed to being catalyzed. This layer of foil provides a base for the subsequent plating operations.

passive — An element or component that does not change its basic value when an electrical signal is applied, for example, an inductor, resistor, or capacitor.

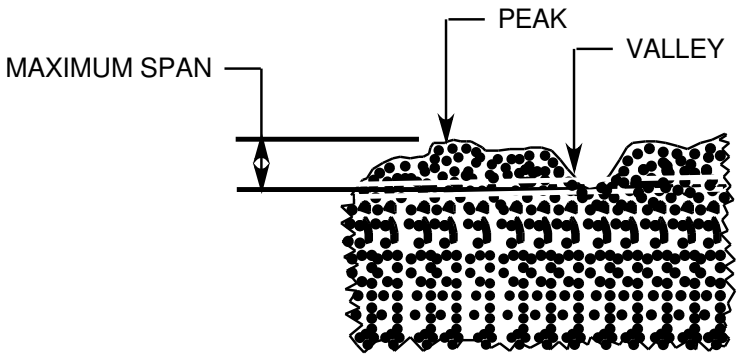
path — Use *conductor*.

pattern — The configuration of conductive and nonconductive materials on a panel or board; also the conductor configuration on the related master drawing, artwork master, production master, and artwork copy.

pattern plating — At Digital, the selective electroplating of a copper and tin-lead conductive pattern on a panel.

peak-to-valley — On the surface of a panel or board, the maximum span of roughness allowed. May also refer to the distance between the outer and inner limits of other surface imperfections such as nodules and solder touchup. See Figure 38.

Figure 38: Peak-to-Valley



peel strength — The force per unit width (lb/in, kg/mm) required to peel a conductor or foil from the base material. Refer to *bond strength*.

permanent mask — A resist that is not removed after processing (for example, soldermask or the plating resist used in a fully-additive process).

photographic reduction dimension — Tells the photolab technician how far the artwork master will be reduced. Such a dimension might be the distance between conductors or between two specified points; its value refers to the one-to-one scale and must be specified.

photoimageable soldermask — A liquid resin-based UV-imageable, thermal-cured soldermask. Liquid photoimageable soldermasks are applied by curtain coat, roller coat, or flood screen coat, then tack dried by thermal bake. The dried film is exposed, developed, and thermally cured.

photomasking — Use *dry-film printing*.

photomaster — Use *artwork master*.

photo-micrograph — A photograph taken while using a high powered microscope for analysis. A photo-micrograph depicts specific features of the sample being analyzed; for example, PWB cross sections.

phototool — A tooled photo reproduction of the artwork master, used in the image transfer process; actually a hinged two-piece flat rectangular clear-plastic carrier for artwork copies, used in dry-film printing.

pick-and-place machine — A programmable machine usually having a robotic arm that picks up components from an automatic feeder, moves to a specified location on a printed-wiring board and places the component at the correct location (onsertion).

pilot hole — Use *tooling hole*.

pilot release — A printed-wiring board designed released to the laboratory for manufacturing prototypes.

pin density — On a board, the quantity of connector pins per unit area.

pin grid array (PGA) — An integrated circuit packaging style, typically a ceramic multilayer body and through-hole pins on a grid system of either 0.100 inch or staggered 0.050 inch.

pinhole — A minute hole through a layer of conductive material. In a solder connection, a small hole that is not larger than the diameter of the component lead. See *void*.

pink poly — See *antistat impregnated plastics*.

pinning — A kitting or lay-up operation that holds panels or panels and laminate materials together and keeps them aligned in a stack for the drilling or lamination process.

pinpoint delamination — Measle-like delamination in base material adjacent to a plated-through hole.

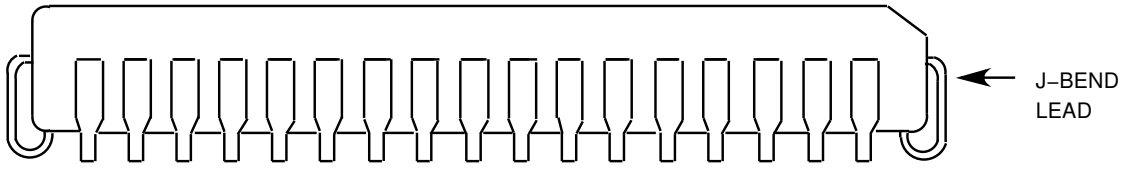
pit — A small hole in a layer of material that does not penetrate entirely through the material.

pitch — The nominal distance from center to center of adjacent conductors. Where conductors are of equal size and spacing is uniform, usually it is measured from the reference edge of a conductor to the referenced edge of the adjacent conductor.

planar resistor technology (PRT) — A process that employs an alternative approach to surface-mounted resistors. The use of internal (buried) resistors which are selectively printed and etched onto innerlayers. This design strategy addresses the need for increased circuit and packaging densities. PRT is a printed-wiring board laminate clad, with both resistive and conductive metal layers.

planar surface — TBD. See Figure 39.

Figure 39: Planar Surface



SIDE VIEW

plant specific — Applies to only one manufacturing facility.

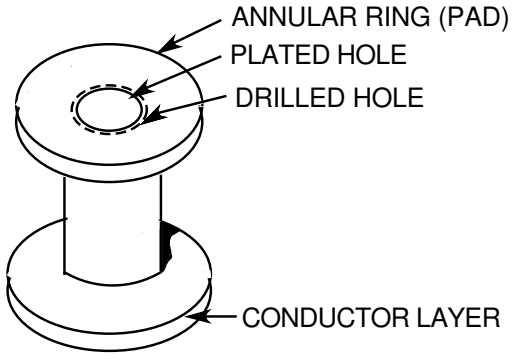
plastic leaded chip (PLC) — A plastic, leaded package for semiconductor dies.

plastic leaded chip carrier (PLCC) — A package in which an integrated circuit chip can be mounted to form a surface-mounted component. It is made of a plastic material that can withstand high temperatures and J-bend leads for connection to a printed-wiring board footprint.

plastic quad flat pack (PQFP) — An integrated circuit packaging style, typically with leads on all four sides which are gull-wing formed for surface mounting.

plated-through hole (PTH) — As seen in the following illustration, an electrical through connection made between inner and/or outer conductor layers. At Digital, this connection is made by the electroless deposition and electroplating of metal on the wall of a drilled hole. See Figure 40.

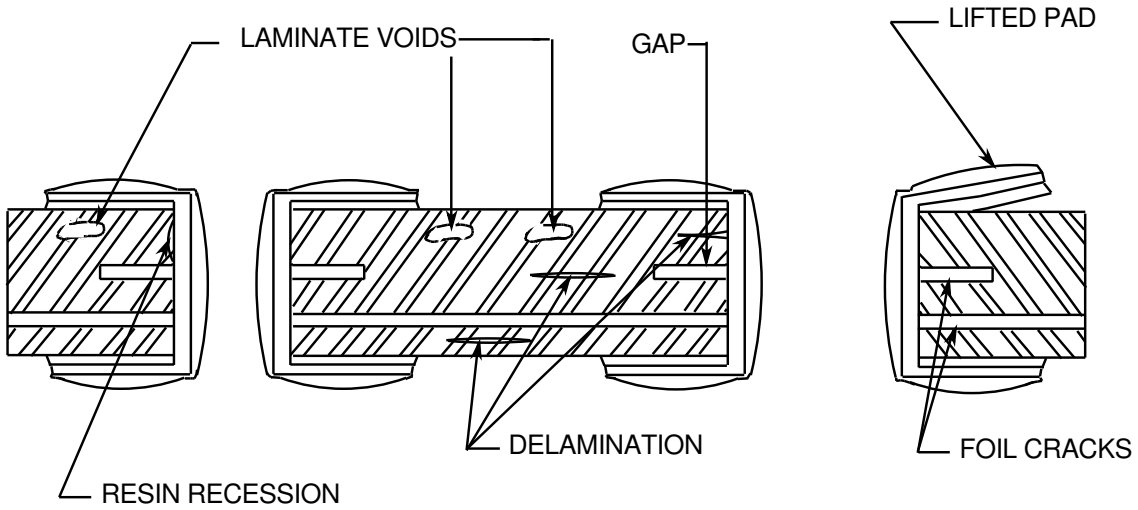
Figure 40: Plated-Through Hole (PTH)



plated-through hole board — A double-sided print-plate-and-etch board in which electrical through connections are made between the outer conductor layers by the electroless deposition and electroplating of conductive materials (copper, tin-lead) on the walls of drilled holes.

plated-through hole imperfections — See Figure 41.

Figure 41: Plated-Through Hole Imperfections

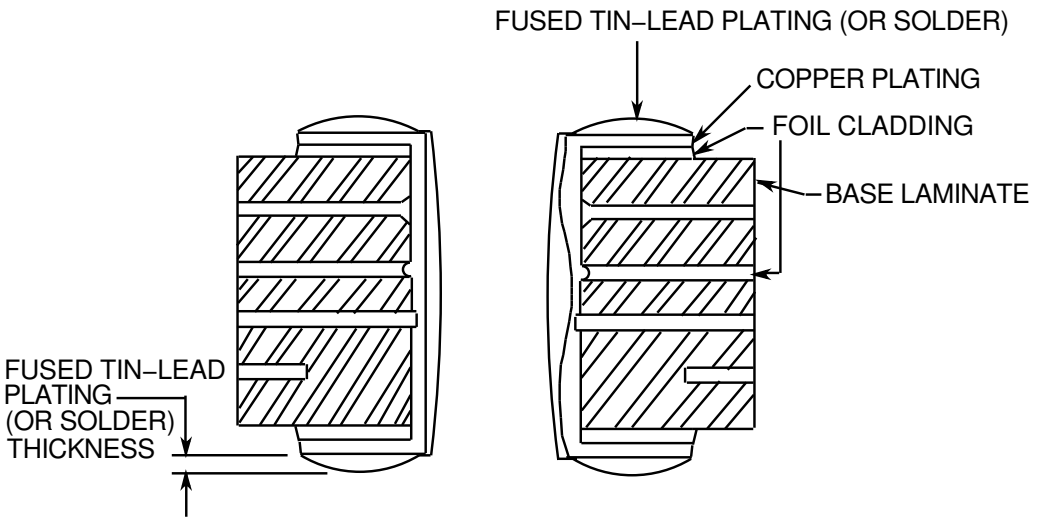


plated-through hole structure test — A visual examination of the metallic conductors and plated-through holes of a board after the base material has been dissolved away.

plate finish — The unmodified finish on the metallic surfaces of copper-clad laminate resulting from direct contact with lamination press plates.

plating — The electroless or electrolytic plating of conductive metal in the holes and on the other surfaces of a panel; also designates the additional layer(s) of conductive metal adhering to the top surface of conductive foil. See Figure 42.

Figure 42: Plating



plating bar — A temporary conductive path interconnecting areas of a panel to be electroplated, usually located outside the borders of the board(s).

plating up — Electroplating additional conductive materials directly on top of the conductive pattern or on the base material after it has been made conductive.

platter — Use *mother board*.

plotting — Converting X-Y positional information into a visual pattern for the artwork master.

plug-in connection — Use *finger*.

polarization — A technique for eliminating symmetry within a plane so that parts can be engaged in only one way in order to minimize the possibility of malfunction or mechanical and electrical damage.

polarizing slot — A locating feature at the edge of a board that ensures its correct insertion and location in a mating connector. Refer to *keying slot* or *notch*.

polar solvent — A solvent that is ionized sufficiently to be electrically conductive; can dissolve polar compounds such as inorganic salts but cannot dissolve nonpolar compounds such as hydrocarbons and resins.

polyimide — Characterized by the cyclic group containing a nitrogen and two carbonyl groups (carbon which are double-bonded to oxygens). The imide groups are structurally planar and very rigid which contributes to the high stiffness and temperature stability of these polymer groups. Large aromatic groups are usually incorporated into the polymer to

further enhance their temperatures and stiffness properties. For applications requiring temperature stability up to 315°C, the resin of choice is generally polyimide or other imides rather than epoxies. (Er = 3.5, Tg = 240°C.)

populated board — Use *module*.

positive — Artwork copy, artwork master, or production master in which the conductive pattern is opaque and the nonconductive pattern is transparent.

positive-acting resist — Decomposed (softened) by light; after exposure and development is removed from laminate surface areas that were under the transparent parts of the production master.

post-baking — Baking of a printed-wiring board, after lamination and/or drilling, at a temperature slightly above the glass transition temperature of the resin in the base material in order to relieve mechanical stresses.

power plane — A conductor layer or portion of same at other than ground potential; may be used as a common voltage source or for shielding or heat sinking. Refer to *ground plane*.

power-plane clearance — Refer to *ground/power-plane clearance*.

pre-baking — The baking of a printed-wiring board prior to heat exposure above 100°C to remove moisture.

preheating — A preliminary operation that raises the temperature of panels or boards above ambient to reduce the effects of thermal shock in a subsequent operation employing a much higher temperature.

prepreg — Woven fiberglass sheet impregnated with resin and cured to an intermediate (B) stage, used to separate, insulate and bond conductor layers in multilayer boards.

press-fit contact — An electrical contact that can be pressed into a hole in a board, insulator or metal plate.

press pin — Refer to *press-fit contact*.

pre-tinning — The coating or plating of a component's leads or pads, or the pads of a printed-wiring board, with a material to improve solderability during assembly.

printed board — The general term for completely processed printed-circuit or printed-wiring configurations. The term can refer to single, double and multilayer boards. Refer to either *printed-circuit board* or *printed-wiring board*.

print-and-etch board — Composed of single- or double-sided copper-clad laminate material wherein all or most of the conductive pattern is formed merely by etching away the unwanted portions of copper foil; may also contain electroplated fingers and drilled and punched holes.

printed-circuit — A pattern composed of copper printed wiring or circuitry formed on a layer(s) of a common rigid or flexible base.

printed-circuit assembly — A printed-wiring board on which separately manufactured components and parts have been added. See *module*.

printed-circuit board — A completely processed conductive pattern ready for assembly. Within Digital, "module" is a synonym for printed-circuit board. See *printed-wiring board*.

printed-circuit facility — At Digital, a printed-wiring board manufacturing facility. Refer to *board shop*.

printed component — An electrical device, such as a resistor, capacitor, inductor or transmission line, within or bonded to the surface of a base material, formed as part of the conductive pattern in a printed-circuit board.

printed contact — Either a finger or another portion of the conductive pattern serving as one part of an electrical contact configuration.

printed edge board contact — The portion of printed-wiring or circuitry used for the purpose of providing external electrical connection to a printed-wiring board by pressure contact and is usually gold plated.

printed-wiring — A conductive pattern within or bonded to the surface of a base material intended for point-to-point connection of separate components. Same as printed-circuit.

printed-wiring assembly — See *module*.

printed-wiring assembly drawing — Refer to *master drawing*.

printed-wiring board — Completely processed printed-wiring configurations (conductor patterns only, no components) on a common base material.

printed-wiring layout — An engineering sketch depicting the printed-wiring substrate, the physical size and location of electronic and mechanical components, and the routing of conductors that interconnect components, all in sufficient detail to allow the preparation of documentation and artwork.

print-plate-and-etch board — A print-and-etch board with an additional layer (or layers) of conductive material electroplated on all the wanted portions of conductive foil. The additional layer or final additional layer of plated material also serves as a resist in the etching process.

process — A series of chemical, mechanical or manual operations performing a major manufacturing function.

process control — Chemical-solution and equipment inspection and maintenance procedures necessary to ensure process outputs of sufficient quality; a production function as opposed to a quality function.

process sheet — A routing and control form that follows each production lot through all applicable processes.

production master — Either the artwork master or a one-to-one reproduction of the artwork master, used to produce artwork copies. A single-image production master is used in fabricating one board at a time; a multiple-image production master is used in fabricating two or more boards simultaneously.

protected ESD area — An area that is constructed and equipped with the necessary ESD protective materials and equipment to limit ESD voltage below the sensitivity level of ESDS items handled therein.

protective bag — See *ESD protective packaging*.

protective work surface — Any work surface specially designed to drain static charges out of an operator's general work area before they can damage ESDS items.

pull strength — Use *bond strength*.

punching — Mechanical method of locating (tooling or registration) holes by piercing, rather than by drilling.

Q

quad board — On one or both sides of a standard board, contains four sets of fingers along one board edge; may contain up to eight sets per board with four sets along one edge and the remaining set(s) along the opposite edge. Refer to *hex board*.

quality assurance — Some in-process but mostly preprocess and after-process monitoring and inspection procedures that assure the production of printed-wiring boards of sufficient quality.

quality control — Mostly in-process but some after-process monitoring and inspection procedures that ensure process outputs of sufficient quality.

R

random access memory (RAM) — A memory from which information at any location can be obtained at the output with approximately the same time delay as that at any other location.

raw board — Use *printed-wiring board*.

raw material — Use *fabrication material*.

reference dimension — Used only for informational purposes, a dimension without tolerance that has no real effect on production and inspection operations.

reference edge — The edge from which measurements are made, sometimes indicated by appropriate marking. Conductors usually are identified by their sequential positions from the reference edge, with the first conductor closest to this edge.

reference grid — Use *grid*.

reference hole/notch — A locating feature. Use either *tooling hole* or *notch*.

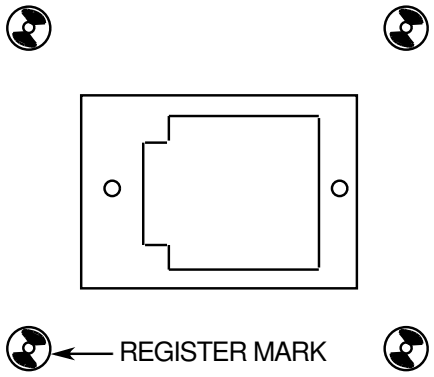
reference plane — TBD

reflow — Use *solder reflow*.

reflow soldering — Joining parts by tinning the surfaces to be joined, placing them together and heating until the solder fuses, and then allowing the surfaces to cool in the joined position.

register mark — A locating feature used for proper positioning in a particular process. See Figure 43.

Figure 43: Register Mark



registration — Conformity of the actual position of a conductor layer or portion thereof with its specified position or with that of any other conductor layer in a board or panel.

registration hole — Use *tooling hole*.

registration target — A mark that enables the accurate overlay of photographic images for registration verification. Refer to *register mark*.

repairing — Restoring the functional capability of a defective product without necessarily restoring appearance, interchangeability and uniformity.

residue — Substance remaining on a module after soldering and cleaning, such as flux or oil.

resin — Polymer matrices that are divided into two general classifications - thermosets and thermoplastics. These two classifications differ by their respective intermolecular structures, with thermosets exhibiting cross-linking in their final state while thermoplastics generally are not cross-linked.

resin recession — A resin void in the base material at the plated-through hole barrel, caused by exposure to high temperatures. See Figure 41.

resin-rich — Contains a significant thickness of nonreinforced surface-layer resin of the same composition as that within the base material.

resin smear — Resin transferred from the base material to a surface or edge of the conductive pattern, normally during drilling. See Figure 41.

resin starvation — An insufficient amount of resin to wet the reinforcement. It is apparent after lamination and evidenced by the presence of weave texture, low gloss, dry spots, and exposed fibers.

resist — Coating or plating material used to protect selected areas of a pattern from the action of solder or an etching or plating solution. In printed-wiring processes, special inks, dry film, plated tin-lead, and adhesive tape are used to protect different parts of the pattern; in component assembly, soldermask is used to prevent bridging in the solder wave process.

resistance soldering — Process of using electric current to heat an area to be soldered.

resolution — The minimum dimension of defect that the machine can reliably detect.

reverse etchback — Use *negative etchback*.

reverse image — The resist pattern used in an image transfer process that permits the exposure of conductive areas for subsequent plating. Refer to *negative*.

reversion — A chemical reaction in which a polymerized material degenerates to a lower polymeric state or the original monomer, usually accompanied by significant changes in physical and mechanical properties.

reworking — The act of repeating one or more process operations for the purpose of improving the yield of acceptable parts.

ribbon cable — Use *flat cable*.

right-angle edge connector — Terminates conductors at the edge of a board while bringing the terminations out perpendicular to the conductor layer.

right reading — Refer to *positive*.

right reading up — Describes the orientation of the conductive pattern with respect to the emulsion side of the artwork. The artwork is *right reading up* when it is right reading (reads left to right) and the emulsion is up or on the near side of the artwork. Conversely, the artwork is *right reading down* when it is right reading and the emulsion is down or on the far side of the artwork.

rigid lead tech — TBD

roadmap — A printed pattern of nonconductive material that delineates the conductive pattern and/or components to aid in the repair of a board or in assembling components on a board.

robber — Use *thief*.

rosin — A type of flux.

rosin connection — A soldered connection containing a layer of solidified flux, evidenced by an increase in electrical resistance and a decrease in physical strength.

S

schematic diagram — Use *circuit schematic*.

scorching — The effect of overheating a surface so as to change its color and texture. Scorching is evidenced by severe discoloration and surface roughness, and possibly charring, delamination and measling.

screenability — An evaluation of how well a solder paste spreads and how easy it is to screen print. It is primarily a qualitative evaluation based on experience.

screening — Refer to *screen printing*.

screen mesh — A structure of woven fibers that supports the emulsion, but does not block the solder paste when used to screen print solder paste on a printed-wiring board. In general, screens have been replaced by stencils.

screen preparation — Transfer of pattern images from artwork copies to stainless-steel or polyester stencil screens for use in screen printing.

screen printer — A mechanical device or machine that supports and aligns the printed-wiring board and a stencil or screen to deposit the solder paste onto PWB lands, or deposit solder paste and nomenclature to the PWB.

screen printing — A mechanical process that applies the image(s) by using a squeegee to force a sizable medium through openings in a stencil screen.

scrubbing — A mechanical (abrasive) cleaning process that uses no chemicals.

sealbrite — The trade name for an organic (resin base) protective coating that maintains the solderability of copper.

seeding — Use *activating*.

seed layer — Produced by activation, metal that is in a chemically active state or nonconductive material that is receptive to the electroless deposition of metal.

selective gold plate — A specialized plating process which will allow for selective deposition of gold metal on specific areas or features of the printed-wiring board.

semi-additive process — Process by which a surface obtains conductive patterns by combining electroless deposition on unclad base material with etching and/or electroplating. Refer to *partial-additive technology*.

semi-insulators — Any materials with surface resistivities from about 104 to 1011 ohms per square or bulk resistivities from about 104 to 1011 ohms-cm. Materials in this resistivity range may or may not safely drain charges sufficient to prevent ESD or field voltage damage to devices. Testing and evaluation of such items is necessary.

sensitive electronic device symbols — The symbols placed on hardware assemblies and documentation for identification of ESDS items. An example of this is the MIL-STD-129 symbol, which is a circle with three inward-pointing arrows. Other symbols used include a bolt of lightning with a slash through it pictured inside a circle, and a hand with a slash through it. Refer to *DEC STD 178-0 Digital Identification Marking Requirements - Introduction*.

sensitizing — Use *activating*.

sensitometry — Analysis of emulsion sensitivity or response as a control on development chemicals and/or light sources.

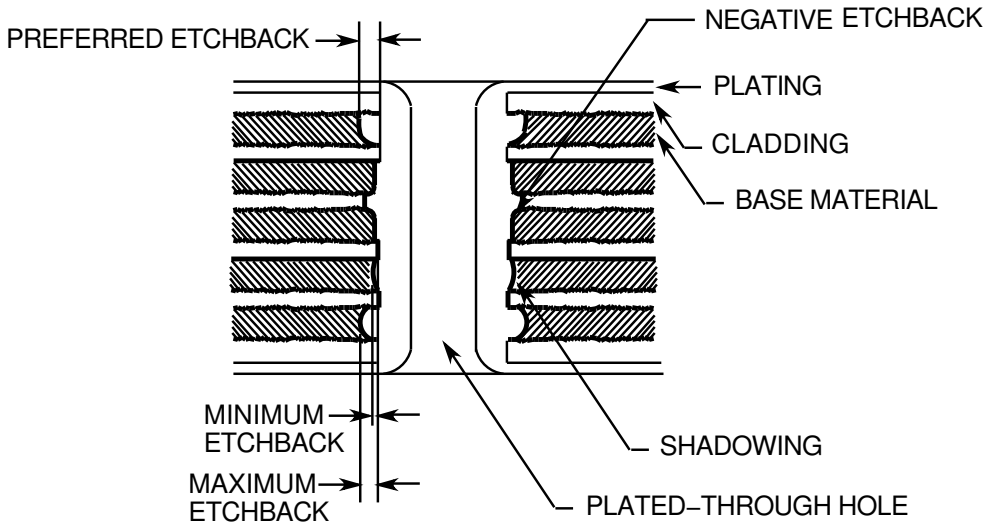
separable component part — A replaceable component that is not bonded chemically to the base material, excluding protective coatings, solder and potting materials.

serialization — Marking panels or boards for identification in subsequent processes.

setup time — In switching over the system to test a different type board, the time required to replace the necessary hardware and software, plus the time to run necessary calibration or verification test to insure the system is ready for operation. Setup time is exclusive of learn time if learn time is not repeated.

shadowing — An etchback imperfection in multilayer board holes, evidenced by inadequate removal of base material adjoining the conductor layers. See Figure 44.

Figure 44: Shadowing



shearing — Cuts sheets into panels, panels into boards, or removes excess conductive and nonconductive material from edges and margins of panels when no longer needed.

shielded pair — A twisted pair of conductors, over which a close metallic braid has been applied.

shielding — A physical barrier that reduces the interaction of electrostatic, or occasionally, magnetic fields with devices, circuits or portions of circuits.

shift — In printed-wiring manufacturing facilities, seven 50-minute work hours.

shoe covers — See *conductive footwear*.

shunting bar — A device that shorts together the terminals of an ESDS system forming an equipotential surface on external conductors.

side 1 — The component side of the printed-circuit board/assembly (opposite the conductive side).

side 2 — The conductor side of a board, opposite of side 1. See *wave side*.

signal — An electrical state of a predetermined voltage, current, and polarity.

signal conductor — Transmits an impressed signal.

signal plane — A conductor layer that carries signals; does not serve as a ground or perform any other fixed voltage function.

silk screening — Use *screen printing*.

single-image production master — Refer to *production master*.

single in-line package (SIP) — A component package with one straight row of pins of lead wires.

single sided — Copper foil or conductive pattern on only one side of the panel or board.

skew — A shift (movement) displayed by a component's lead frame off the center line of its mounting pads.

slivers — Portions of plating overhang (solder, tin, gold, and so forth) on conductor edges partially or completely detached. Use *whisker*.

slot — A locating feature. Refer to *keying slot*, *polarizing slot*, and *notch*.

small outline integrated circuit (SOIC) — A surface mount variant of the through-hole dual-in-line integrated circuit package.

small outline j-leaded package (SOJ) — A small outline integrated circuit with J-bend leads.

small outline transistor(SOT) — A surface mount variant of the traditional transistor package styles.

smear removal — Refer to *chemical hole cleaning*.

snap-off distance — The distance between the surface of the printed-wiring board and the screen when they are mounted in a screen printer. After the squeegee deflects the screen to the PWB and passes over, the screen must *snap off* to the original position.

soft tooling — Artwork master and punched drilling and routing tapes.

solder — Ordinary soft solder is a fusible alloy consisting of essentially tin and lead used for the purpose of joining together two or more metals at temperatures below their respective melting points.

solderability — A qualitative measure of the ability of printed-wiring board pads or of a component's leads or pads to be completely wetted by molten solder.

solder balls — Very small balls of solder that separate from the main body of solder that forms the joint. Primarily caused by excessive oxides in the solder paste that inhibit solder coalescence during reflow.

solder bridging — Unwanted formation of a conductive path by solder between conductors.

solder connection — An electrical/mechanical connection that employs solder for the joining of two or more metal parts.

soldered side — The side of the printed board that is opposite to the component side. Use *conductor side*.

solder fillet — A blended or meniscoid (rounded) configuration of solder around a component or wire lead and land. Refer to *fillet*.

solder impurities — The contaminants that appear in a solder bath during usage that may degrade the quality of the finished solder joint.

soldering — A process of joining metallic surfaces with solder, without the melting of the base metals.

soldering oil (blanket) — Liquid formulations for use in oil intermix wave soldering equipment and as pot coverings on still and wave solder pots to eliminate dross and reduce solder surface tension.

soldering reflow — A process in which solder paste is deposited on pre-tinned pads on a printed-wiring board and the component's pre-tinned leads are placed on the paste. When the assembly is heated to the proper temperature, the solder paste melts and the solder on the leads and pads reflows to form a solder fillet.

soldering, vapor phase reflow — A type of reflow soldering in which the printed-wiring board assembly is passed through a vaporized inert fluorocarbon. The latent heat given up when the fluorocarbon condenses causes the solder to reflow.

solderless wrap — Connects a solid wire to a square, rectangular or V-shaped terminal by tightly wrapping the wire around the terminal with a special tool.

soldermask — A permanent polymer coating or photopolymer film added to one or both sides of a printed-wiring board to prevent bridging in the solder wave (component assembly) process.

soldermask over bare copper (SMOBC) — A printed-wiring board process that results in surface interconnecting etch, which is bare copper encapsulated by soldermask. All solderable surface features are coated with eutectic solder as opposed to plated reflowed tin lead. The purpose of this design approach is to eliminate solder bridging and solder balls during assembly processing.

solder paste — A homogeneous mixture of powdered metal alloy, a flux system, and a viscosity modifier. During a solder reflow operation, the metal alloy melts to form the solder joint while the viscosity modifier evaporates. The flux is removed during the cleaning operation.

solder plug — The core of a soldered plated-through hole.

solder projection — An undesirable protrusion of solder from a solidified solder joint or coating. Also called *icicles*.

solder reflow — Solder reflow is a printed-wiring board fabrication process that converts plated tin and lead into solder by providing sufficient heat to melt the plated metals. There are various methods to make plated tin-lead reflow to form solder: infrared and vapor phase, for example.

solder resist — Refer to *resist*.

solder short — Refer to *bridging*.

solder source side — The side of the printed-wiring board that a molten solder bath contacts or the paste or the preform is applied.

solder splashes — Drops, balls, or flakes of solder in areas that should be free of solder.

solder stripping — Use *finger stripping*.

solder webbing — A continuous film or curtain of solder parallel to, but not necessarily adhering to, surface or between separate conductive patterns that should be free of solder.

spacing — Refer to *center-to-center spacing, conductor spacing, conductor-to-hole spacing, contact spacing, edge spacing* or *layer-to-layer spacing*.

span — The distance from the reference edge of the first conductor to the reference edge of the last conductor, expressed in inches and/or millimeters.

spark discharge — The discharge of static electricity through air from one conductor to another through a dielectric medium.

special feature — Commonly used board feature that is converted into data and merged with the computer data base when required for simplification and consistency of plotting. Use either *engineering special feature* or *manufacturing special feature*.

split lug — A terminal containing a slot in which wires and leads are placed prior to soldering.

spur — A projection or protrusion extending from the edge of a photographic pattern, or an anchoring spur on a flexible board.

spurious signal — Use *crosstalk*.

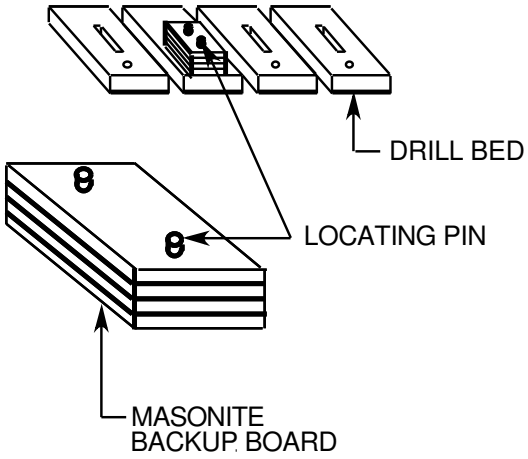
squeegee — A rubber blade used in screen printing that moves across the screen forcing the solder paste through the stencil onto the footprint.

stable base material — A drafting material having good dimensional stability, used for making artwork masters.

stack board — Used in a computer memory application to mount cores and wiring.

Stackmaster — The trade name for a manually operated machine that pins panels together in stacks suitable for drilling. See Figure 45.

Figure 45: Stackmaster



stamped printed-wiring — Produced by die stamping and bonding to an insulating base.

standard board — A standard board is one described in *DEC STD 030-0 Module Manufacturing Standard - Introduction and General Information*.

starring — Hole-wall pullaway (delamination) in a plated-through hole.

start-up time — In printed-wiring facilities, the time lost at the beginning of each workday while waiting for machines and/or chemical solutions to reach operating temperatures; does not include time consumed by solution transfers and machine loading factors.

static dissipative ESD protective materials — Materials having a surface resistivity of at least 1×10^6 ohms/square, or 1×10^4 ohms-cm volume resistivity, but less than 1×10^{13} ohms/square, or 1×10^{11} ohms-cm volume resistivity.

static electricity — Electrical charge at rest. The electrical charge is due to the transfer of electrons within a body (polarization) or from one body to another.

stencil — The recommended media used to enable the precisely controlled deposition of solder paste on a printed-wiring board.

step-and-repeat — A photographic method by which successive exposures of a single image are made to produce a multiple-image production master.

step scale, step-wedge — Use *gray scale*.

stopping off — Applying a resist or filling in a portion of a cavity to keep out molten metal or some other fluid. Refer to *tenting*.

straight-through lead — A component lead that extends through a hole in a printed board without subsequent forming of the lead.

strand — One of the wires or group of wires of any stranded conductor.

stress relief — The formed portion of a component lead or wire lead, providing sufficient lead length to minimize stress between terminations.

strip gap — The distance between the wire insulation and the soldered terminal.

stripline — A transmission line configuration consisting of a single narrow conductor parallel to and equidistant from two parallel ground planes.

stripping and etching — A chemical process that removes resist material and then removes unwanted portions of copper foil from panels.

subcontractor — Use *supplier*.

substrate — The base material that forms the support structure of an integrated circuit or printed-wiring board. Use "base material" when referring to the dielectric.

subtractive process — Produces conductive patterns through the selective chemical removal of unwanted portions of conductive foil from copper-clad laminates. Refer to *additive process*.

supplier — The organization from which Digital purchases fabrication materials or printed-wiring boards.

supported hole — A board hole with its inside surface plated or otherwise reinforced.

surface breakdown — A voltage-dependent failure mechanism explained as a localized avalanche multiplication process caused by narrowing of the junction space charge layer at the surface. This results in a high leakage path around the junction, thereby nullifying the junction action. This failure mechanism depends on numerous variables such as geometry, doping levels, and others.

surface insulation resistance (SIR) — A test method that determines the resistive aspects of an insulative material in the presence of electrical biasing and harsh environmental (mixed flowing gases) conditions.

surface mount assembly — SMA.

surface mount pin grid array (SMPGA) — A surface mount variant of the through-hole PGA package.

SMT — Surface mount technology.

surface mounted component — Components designed to be mounted directly on and soldered to pads on the surface layer of a printed-wiring board (rather than inserted into through-holes). Surface mounted components include leaded actives (chip carriers of both J-bend and gull-wing designs, SOICs, chip passives, SOTs, and discretes).

SMT pad layer — The outermost layers of a printed-wiring board having pads; SMT component footprints with dispersion patterns to the vias, and short connections to test pads and edge connectors. Either or both of side 1 and side 2 can be pad layers.

surface resistivity — A measure of ionic (electrically active) contaminant levels on the surface of a board, expressed in megohms.

surface resistivity-ps — An inverse measure of the conductivity of a material equal to the ratio of the potential gradient to the current per unit width of the surface, where the potential gradient is measured in the direction of current flow in the material. It is numerically equal to the surface resistance between two electrodes forming opposite sides of a square of the material. The size of the square is irrelevant. The units are ohms (per square).

surface treatment — A chemical process that adds an oxide conditioner to inner layer boards in order to improve bonding characteristics in lamination.

surfactant — See *topical antistat*.

swaged lead — A component wire extending through the board and flattened on the other side; secures the component during assembly operations.

T

tab — Use *finger*.

tab terminal — A terminal containing a tab or hole, through which wires are placed before soldering.

tack soldering — A manual method for fastening a component lead or jumper wire to a pad, finger or component lead.

tape — Nonadhesive punched paper tape that provides control data for drilling, routing and other manufacturing operations; adhesive tape used as a resist in stripping and plating processes.

Tape Automated Bonding (TAB) — An interconnect method that uses etched conductors (copper) stabilized by a dielectric film (polyimide). TAB has emerged as a principal technology to meet the needs of high device terminal count and improved system performance. TAB is analogous to wire bonding, but provides many additional advantages; primarily the allowance of closer spacing of bond pads on the die, higher pin counts, high density and potential lower cost. Refer to *HPTP*.

taped components — Board components attached to a tape for use in an automatic component insertion process.

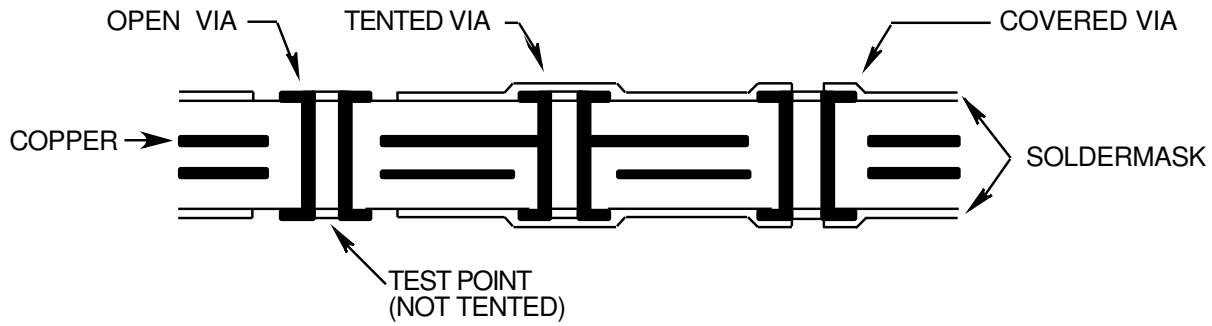
taping — Prior to finger stripping, the application of adhesive tape to protect printed-wiring above the fingers in the finger stripping and finger plating processes.

temperature coefficient of expansion (TCE) — The expansion rate of a material, measured in ppm/°C, as a function of temperature.

tented via — A via that is covered with soldermask so as to seal the drilled hole.

tenting — Covering over plated-through holes and the surrounding conductive pattern with a resist material, usually dry film. See Figure 46.

Figure 46: Tenting



terminal — A metallic termination device used for making electrical connections.

terminal area — The portion of a printed-circuit or wiring used for making electrical connections to the conductive pattern or component. Refer to *pad* or *terminal pad*.

terminal clearance hole — Use *access hole*.

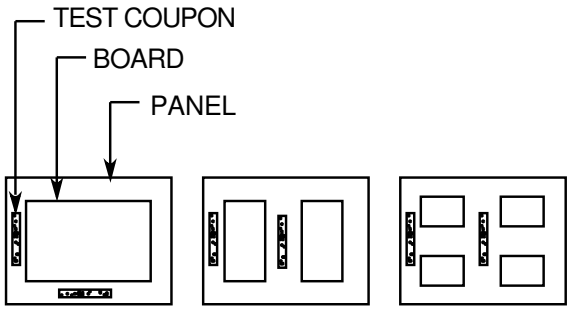
terminal hole — Use *component hole*.

terminal pad — Refer to *pad*.

test board — A printed-wiring board suitable for determining the acceptability of a batch of boards (lot) produced using the same or similar processes. Refer to *first piece*.

test coupon — A portion of a panel containing electrical and microsectional test patterns that will be used to determine acceptability and then removed. See Figure 47.

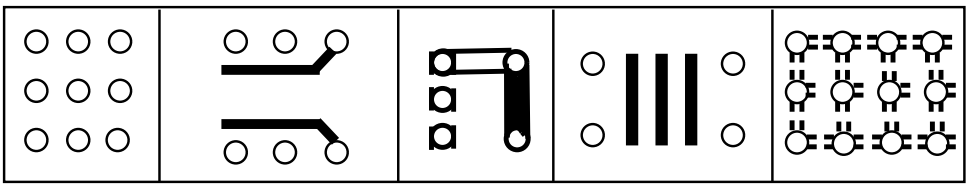
Figure 47: Test Coupon



test grid — Test pads placed "on grid" to serve as physical access electrical test points. Usually, only one test point is required for every electrical network. Test pads should be placed on grids.

test pattern — Fabricated on a test coupon for inspection or testing purposes. Some typical patterns are shown in Figure 48.

Figure 48: Test Pattern



test point — Special point of access to an electrical circuit; used for testing purposes.

termination band — Metal conductors located at the end of a chip component for attachment to footprint pads or a printed-wiring board.

thermal conductivity — Measured value that determines a material's ability to transmit/conduct thermal mass; measured units Btu/hr_ft °F, J/s_cm °C [W/m_K].

thermal fatigue — The failure of materials subjected to alternating heating and cooling.

thermal management — Consideration and use of the various methods for dissipating heat produced by operating electronic equipment so that the operating temperature specifications of the components are not exceeded.

thermal relief — Crosshatching that minimizes blistering or warping during soldering operations.

thermal resistance — Indicates the rate of change of junction temperature with respect to power dissipation.

thermoplastic — A polymer system which is melted, formed and then cooled to achieve final form. An example is PTFE (polytetraflouroethylene).

thermoplastic resins — These are solid polymers that are melted, formed, and then cooled to achieve their final form, such as PTFE (polytetrafluoroethylene).

thermoset — A polymer system that is heat activated (cured) to achieve crosslinking of its molecular structures. An example is epoxy.

thief — A racking device used in electroplating processes to provide a more uniform current density by absorbing unevenly distributed current, thereby ensuring that panels receive an electroplated coating of uniform thickness.

thieving bar — Use *plating bar*.

thin foil — Foil cladding that is less than 0.018 mm or 14.2 grams (0.0007 inch or 0.5 oz) thick.

through connection — An electrical connection between conductor layers on opposite sides of an insulating base. Refer to *clinched-wire through connection, eyelet, interfacial connection, plated-through hole* and *via hole*.

through-hole board — A printed-wiring board that has holes through it so that component leads can be inserted through the board and soldered on the other side.

through-hole mounting (intrusive) — A method of attaching a component to a printed-wiring board using a lead and a plated-through hole.

tie bar — Use (plating bar).

tinning — The process of coating conductive paths or terminals with solder for the purpose of decreasing in-process oxidation and improving their solderability.

tombstoning — A condition wherein an SMT chip component (resistors, capacitors, transistors) stands upright or nearly upright on its terminal ends, typically following reflow.

tone — When expressed as positive or negative, identifies an artwork feature as being opaque or clear.

tooling feature — Refer to *locating feature*.

tooling hole — A mechanical locating feature that is used to position a panel accurately in a process or operation.

topical antistats — Chemical agents which, when applied to surfaces of insulative materials, will reduce their ability to generate static. This reduction is usually accomplished by increasing the surface lubricity of the material. A secondary effect of ionic hygroscopic antistats is that they usually also increase the surface conductivity, thereby delocalizing any triboelectric charge produced and allowing a slow bleed-off of charge if the material is properly grounded. See also *antistat impregnated plastic*.

torque — Twisting force applied to a nut or screw to tighten it.

Total Quality Control(TQC) — TBD

total surface mount assembly — A printed-wiring assembly in which all components are surface mount and there are no through-hole components.

tote box — A rectangular ribbed plastic container used for transporting panels and boards.

trace/track — Use *conductor*.

transmission cable — Two or more transmission lines; structure may be flat or round (for example, jacketed group of coaxial cables).

transmission line — A signal-carrying circuit composed of conductors and dielectric material with controlled electrical characteristics, used for the transmission of high-frequency or narrow-pulse signals.

traveler — Use *process sheet*.

treatment — Processes that chemically or mechanically modify one or both sides of copper foil to enhance adhesion to the base material (prepreg or base laminate); should not degrade the foil or base material and should be removable from the base material in a normal etching operation.

treatment transfer — The transfer of copper-foil treatment to base material, indicated by the presence of black, brown or red spots or streaks, or much larger blotches, after the foil has been removed by etching.

triboelectric charging — The generation of electrostatic charges when two pieces of material in intimate contact are separated (where one or both is an insulator). Substantial generation of static electricity can be caused by contact and separation of two materials or by rubbing two substances together. See also *triboelectric series*.

triboelectric effect — The acquired charge caused by the separation of two materials, one of them an insulator. See *triboelectric charging*.

triboelectric series — A list of substances in an order of positive to negative charging as a result of the triboelectric effect. A substance higher on the list is positively charged when rubbed with a substance lower on the list. The order of ranking in a triboelectric series is not always a constant or repetitive. Furthermore, the degree of separation of two substances does not necessarily indicate the magnitude of the charges created by the triboelectric effect. The order in the series and the degree of the charge depends on many factors such as surface cleanliness, ambient conditions, pressure of contact, speed of rubbing or separation, lubricity, and the amount of surface area over which the rubbing occurs.

NOTE

A material in close contact with itself may also charge to opposite polarities.

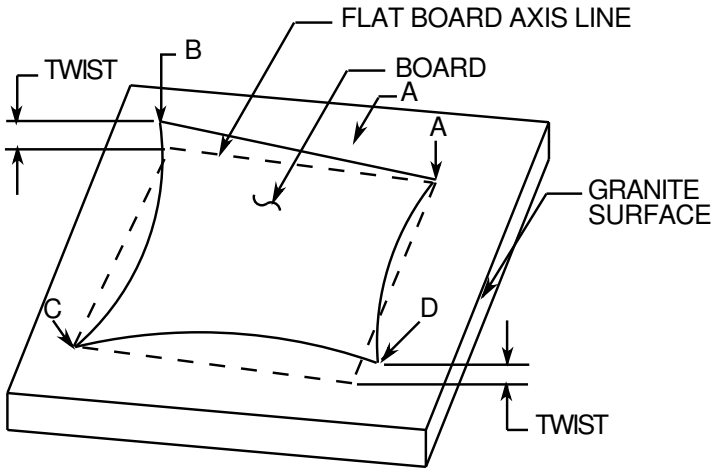
trim line — Defines a border on a printed-wiring board. Refer to *corner mark*.

true position — A theoretically exact location established by the basic dimension.

true position tolerance — The total diameter of permissible movement around the true position as shown on the master drawing.

twist — A bending or curving deviation from the flatness of a rectangular sheet, panel or board that occurs when one of its corners is not in the plane containing its other three corners. Refer to *bow*. See Figure 49.

Figure 49: Twist



NOTE: POINTS A AND C ARE TOUCHING GRANITE SURFACE.

two-sided — Use *double-sided*.

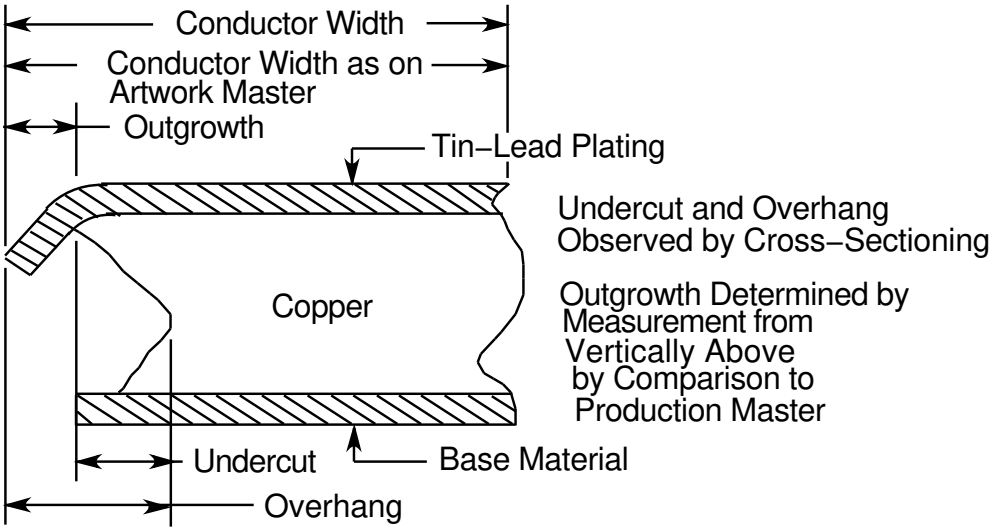
U

UL-94 Flammability Rating — Title of the Underwriters Laboratory standard set for the flammability test rating of various materials.

unacceptable — The level below the incidental defect condition whereby a product that contains a critical or major defect must be either reworked, to bring it to the acceptable condition, or scrapped, if it is not repairable. See *minor defect* for an exception to this.

undercut — A groove or excavation along the edge of a plated or unplated conductor, caused by lateral etching; if conductor is plated, undercut begins just under the plated material. See Figure 50.

Figure 50: Undercut



underside attachment assembly — An assembly on which only chip passives, discretes, and SOTs are used along with through-hole components. These SMDs are surface-attached to the bottom side (side 2) of the board only. The intrusive components are inserted on side 1 of the board.

underwriters symbol — A logo authorized for placement on a product that has been accepted by Underwriters Laboratories, Incorporated. This logo may be one of two types of symbols by UL for UL-listed or UL-registered products.

unload time — The time required to remove the tested printed board from the machine.

unsupported hole — A board hole with no inner plating or other type of reinforcement; may be a tooling hole.

V

VAX Layout System(VLS) — Layout system for designing printed-wiring boards. A CAD system.

vehicle — The liquid contents that allow the solid metal particles (Sb-tin and Pb-lead) to flow in the solder paste.

vendor — Use *supplier*.

vertical board edge — Does not contain fingers and is perpendicular to the edge(s) containing fingers.

very-high-density board — A multilayer or multisignal-layer board where nominal conductor widths and spacing are a maximum of 0.30 mm (0.012 inch) and 0.33 mm (0.013 inch) respectively, and nominal pad diameters are a maximum of 1.52 mm (0.060 inch).

via — An interlayer connection in a multilayer board.

via hole — A noncomponent plated-through hole used only to connect to one or more layers of a printed-wiring board.

via in pads (VIP) — A process whereby vias are placed in SMT pad designs. These vias may be incorporated at specific locations within the SMT pad (center, right side, left side or outside/adjacent). This design change is a result of high speed chip functionality, operating at high frequencies which are affected by high inductances.

viscosity — The characteristic of liquids (or creams) that determines their resistance to flow. High viscosity means more flow resistance. Solder paste viscosity can be modified with a special thinner. Viscosity is usually measured in centipoise (Cps).

visual — As seen with the naked eye assuming 20/20 vision.

voids — Cavities inside the solder joint formed by gases that are released during reflow or by flux residues that fail to escape from the solder before it hardens. The complete area of absence of a specific metal from a certain area. Voids such as pin holes or blow holes result from the formation of gas pockets in the PTH during soldering. The gas may be from the flux solvents or from the materials being soldered.

voltage plane — Use *power plane*.

volume resistivity - pv — An inverse measure of the conductivity of a material and equal to the ratio of the potential gradient to the current density where the potential gradient is measured in the direction of current flow in the material.

W

warp — For sheets, panels and boards, use either *bow* or *twist*. In base material, the warp is the threads of the reinforcing glass fabric that ran in the machine or rolled direction of the basic roll of fabric when it was woven and processed. Fabric is usually stronger in the warp direction than in the fill direction.

wave soldering — A Digital component assembly process wherein printed-wiring boards are brought into contact with the surface of continuously flowing and circulating molten solder. Refer to *dip soldering* and *drag soldering*.

work cell controller (WCC) — Hardware and software that controls and coordinates one or more related workstations.

weave exposure — Occurs at the surface of base material when unbroken fibers of woven glass cloth are not covered completely by resin. See Figure 14.

weave texture — As shown above, a base-material surface condition in which the unbroken fibers are covered completely by resin but the surface exhibits a definite weave pattern.

wet lab — A process control laboratory where chemical process attributes are analyzed.

wetting — The formation of a relatively uniform, smooth, unbroken and adherent film of molten solder or some other liquid on the surface of a panel or board. Refer to *dewetting* and *nonwetting*.

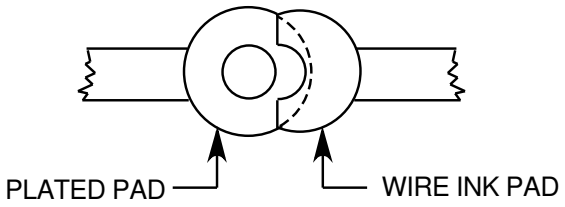
whisker — A slender needle-shaped metallic growth on a printed-wiring board. Refer to *solder projection*. Also, see Figure 11.

wicking — Capillary absorption of liquid along the fibers of base material or the removal of molten solder through capillary action.

width — The dimension of a printed-wiring board that is measured parallel to fingers or finger edge.

wire ink — An adherent fluid containing metallic particles that is formed into conductors and pads using screening process. Replaces hardwiring in making engineering changes on soldermasked boards. See Figure 51.

Figure 51: Wire Ink



wirewrap — The name for a particular solderless-wrap connection process.

wire stripping — The removal of the outside insulation on a wire.

wiring pattern — Use *conductive pattern*.

workmanship standard — Photographic illustration and/or line drawing accompanied by a few explanatory sentences; explains the degree of quality required under certain circumstances. Many such standards are broken down into the categories of preferred, acceptable and not acceptable.

wrist strap — See ground straps.

wrong reading — Refer to *negative*.

X

X-ray inspection — The use of radiology inspection techniques, usually after drilling, to assure correct alignment of the inner and outer layers of a multilayer panel.

Z

zero insertion force (ZIF) - TBD

zigzag in-line package (ZIP) - A through-hole leaded package with a single row of leads exiting the component body; the leads are formed to fall into a staggered, rather than straight, row of holes.

APPENDIX A REFERENCED DOCUMENTS

A.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00030-00	*DEC STD 030-0 Module Manufacturing Standard - Introduction and General Information*
EL-00030-09	*DEC STD 030-9 Module Manufacturing Standard - Surface Mount Technology Design Rules*
EL-00030-10	*DEC STD 030-10 Module Manufacturing Standard - Footprint Design for Surface Mount Technology*
EL-00178-00	*DEC STD 178-0 Digital Identification Marking Requirements - Introduction*
EL-MF417-01	*Surface Mount Technology Reference Manual - 2 Volume Set*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

A.2 Other Documents

Document Number	Document Title
DOD-STD-1686	*Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment.*
MIL-STD-883 (3015)	*MIL-STD-883, Method 3015; Electrostatic Discharge Sensitivity Classification*

A.3 Ordering Information

Following are the sources for documents not available from Standards and Methods Control.

- Federal Standards, Military Standards, Naval Publications, and Forms Center:
  5801 Tabor Avenue
  Philadelphia, PA 19120
  Telephone (215) 697-3321

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